ELECTRICAL WORLD
AND
Electrical Engineer.

ELECTRICAL WORLD, Vol. 33, No. 14. NEW YORK, APRIL 8, 1899. ELECTRICAL ENGINEER, Vol.. 27, No. 570.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(Incorporated).

9 MURRAY STREET, NEW YORK.

Telephone Call: 924 Cortlandt. Cable Address: Electrical, New York.

Chicago Office, - - - - - - Monadnock Block.
Philadelphia Office, - - - 929 Chestnut Street.

T. C. Martin and W. D. Weaver, - - - - - Editors.
Carl Hering, - - - - - - - Special Contributor.

J. M. Wakeman, - - - President and General Manager.
T. C. Martin, - - - - - - - Vice-President.
A. C. Shaw, - - - - - - - - Secretary.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - per year, $3.00
Foreign Countries within the Postal Union, - - - - - 6.00
Single Copies, - - - - - - - - - - .10

In requesting your address changed, give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

NOTICE TO ADVERTISERS.

Changes in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

NOTICE TO READERS.

Readers of ELECTRICAL WORLD AND ENGINEER are earnestly requested to notify this office of the non-delivery or delayed delivery of this paper. The publishers will take immediate action, in every case, to see that all readers, whether receiving the paper by mail or through newsdealers are served regularly and promptly.

NEW YORK, SATURDAY, APRIL 8, 1899.

CONTENTS.

	Page
Editorial	427
Chicago & Milwaukee Three-Phase Electric Railway, by S. S. Sherman	431
The Value of Electric Brakes as Recuperating Devices for Automobiles, by F. B. Booth	435
Experiments with the Wehnelt Interrupter, by George T. Hanchett	436
The Cost of Speed in Rapid Transit Service, II., by J. R. Cravath	437
Electricity in the Italian Navy. IV., by Guilio Martinez	439
Agreement Between the Manhattan Elevated and Third Avenue Railways	442
Current News and Notes	443
Digest of Current Electrical Literature, Compiled by Carl Hering	446
Gas Engines for Electric Lighting, by James M. Cremer	452
Wall Switch Rheostats	453
A Belted Exhaust Fan	453
New Iron Foundry at Schenectady, N. Y.	454
DEPARTMENTS:	
Financial Intelligence	455
Special Correspondence	456
General News	458
Personal Notes	460
Legal Note	460
Trade and Industrial Notes	460
Record of Electrical Patents	462

Standardizing Independent Telephony.

Some of the more recent independent telephone conventions, such for example as that in Ohio, have expressed their desire for standardization. It has, indeed, been one of the obvious needs of the time when several independent exchanges and separate toll lines have been brought together in one co-operating system. Whether efforts towards standardization are made consciously or not, they are to be commended, for they make directly for economy and efficiency. We quote this week at first hand the declaration of those who may be regarded as the leading spirits in the attempt to consolidate a number of the independent telephone manufacturing interests. It will be seen that they lay special emphasis on this feature of their campaign. That some of these makers of apparatus should "get together" sooner or later was inevitable, and plans have, indeed, been afoot for months. It looks now as though the consolidation of several factories will go through. But even should it not, the recognition of the importance of standardizing apparatus as thus insisted upon by the manufacturers and the associations alike, is one of the most encouraging features of independent telephone engineering that has yet been brought to notice. Smooth working will win as many subscribers and friends for the new exchanges as low rates that cannot always be maintained.

The Electric Motor and Small Steam Engines.

One of our mechanical contemporaries—the organ of the stationary engineer—announces in the leading editorial of its current issue, that the days of the engine tender are numbered. It is gratifying to obtain from such an unexpected source a recognition of the growing applications of electric power, for until quite recently the mechanical world was inclined to look upon the electric motor as an unwelcome interloper. Among the grounds given for the opinion expressed is that the small power user can buy a reliable electric motor and connect it up cheaper than he could buy and pipe up a boiler and engine of equivalent horse power. The motor, moreover, is subject to little deterioration from use, costs little for repairs and will probably be more salable than the boiler and engine in the case of forced sale. While the boiler of an engine equipment must be fired in the morning and kept under steam all day, however much or little work there is to be done, the motor can be started when required by the simple pulling of a switch, and shut off when the demand ceases. Other advantages adduced are that the motor demand for the current is in proportion to the work done; there is no danger, and practically no expense for attendance; the small steam engine is notoriously uneconomical, using easily from 60 to 70 pounds of steam per hour per horse-power, which means from 12 to 15 pounds of coal per horse-power-hour. The report of a steam boiler inspector in Philadelphia is quoted to show the tendency of the removal of steam power and substitution of electric motors, at present 625 boilers in a total of 3575 having been thus displaced in Philadelphia. While the engine builder may wince at the attitude of our contemporary, it is but the logical

outcome of a situation becoming daily more favorable both to the motor manufacturer and to the central station manager.

Large Questions in City Transportation.

It must be admitted that never before were the dwellers in the larger American cities confronted with more important questions than now await their decision in the matter of transportation. Hardly a city in the Union can be said to have reached a close approximation of service to necessities, but prospects open up in some of them of an early solution of some of the problems. New York City seems to be at last nearing the time when its people can go from the Battery to Harlem in 15 minutes, for not only has the Metropolitan Street Railway Company offered a comprehensive system of subway, elevated, viaduct and surface transfer travel, but the Manhattan Elevated Company has now joined hands with the Third Avenue Railway to do even better in the way of facilities. It may be that the latter union of forces is but one more step in the final unification of all the travel in the city and its continuously adjacent suburbs. When we note that last year the elevated and surface roads in the boroughs of Manhattan and the Bronx carried about 620,000,000 passengers, the magnitude of the interests at stake can be readily imagined; while the rapid increase since 1880, when all the travel was only 200,000,000, shows what possibilities are still in store for electric traction.

An express fare of eight or ten cents, perpetual franchises, rights to use the subways as carriers for all wires and cables, are all points for discussion, but it is certain that no such large sums as are required will be spent unless fair concessions are made to those who are willing to risk their capital. There is, of course, one alternative in having a city own its system, and leasing it to a private company for operation. In Detroit the people have apparently just decided to do the whole thing themselves, and are now getting ready to buy up local street railways for a price that may range anywhere from $12,000,000 to $15,000,000. We incline to the belief that New York City stands to come the better off by not pledging its own resources and by not adding thousands of employees to its payrolls. Another point not yet touched on is the flexibility that private lines have in crossing physical civic boundaries, and in joining on to or owning other lines for the benefit of their passenger and of their own revenues. Just how a city could do this under favorable conditions is not very clear. A city might own a telegraph or telephone system, but inseparable difficulties would arise in getting outside the corporate limits, and electric street car lines would be similarly bounded by many conditions of obvious difficulty.

Electrical Theories.

One of the consequences of the popular belief that electricity is an inscrutable mystery appears to be that any one, however little qualified in that branch, feels warranted in proposing a theory accounting for its supposed mysteries. Nor is the basis for this condition altogether illogical or absurd—at least from one standpoint. The prevalent belief that all intellectual thought thus far brought to bear on electricity has been fruitless in elucidating its ultimate constitution is due to a great extent to those who, though having but a fortuitous connection with electrical science, are yet often accepted as qualified spokesmen; and the confession of impotence implied in the utterances of these encourages the enterprising speculator to enter the field of boundless possibilities for theorizing thus presented to him. As an example of one of these speculations, we give the following from a pamphlet before us, written by a physician:

The author first clears the field by disposing of current scientific fallacies. An ice lens, he says, will converge the rays of the sun to a focus and set fire to combustibles, and no person possessed of a competent faculty of thinking and reasoning will, he believes, venture to assert that actual heat can come from the sun to the earth through 93,000,000 miles of cold and darkness of space and pass through a lens of ice and ignite combustibles. It follows that something which is neither hot nor bright comes instantaneously and incessantly from the sun to the earth and awakens our atmosphere to heat, light and power. The sun, consequently, may be dark, cool and habitable and filled with light, intelligence and beauty, like unto the earth, and still heat and light the satellites the same as now. These facts the author asserts are conclusive, and clearly show that the present theory of an incandescent ever-consuming sun is an absurdity and a stigma upon science. The assertion is made that "the sun does not consume; that for millions of years it has not been known to lessen a single foot in its dimensions or a single foot-pound in its energy." The "fireball" sun of science must therefore be relegated to the shades of a misty past, and Motion, as a cosmical principle take its true and just position in the great cosmical field.

But how do the motions of the heavenly bodies become transmuted into every form and manifestation of force? The author's reply is that this is no longer a mystery. The explanation, he says, is "simple, very simple." The earth is a magnet with a magnetic axis and poles. The sun and all stars are magnets polarized in immensity. The sun in motion, acting and retroacting in concert with its celestial neighbors, becomes a stupendous dynamo-magnet, with all the powers which its vast mass and its inconceivable velocities imply. Following the statement that it is a principle of electrical science that two bodies rotating near each other disturb and set in motion electrical currents in both bodies, the final conclusion is given in display type, "Electricity is the universal force." It appears that this is not the first time the author has offered a theory of electricity, for in a sheet sent with the book we find the following commendation, extracted from—an electrical journal!: "An electrical return current to the sun is truly a sublime idea, and the world is indebted to the author for the lucid manner in which he explains it in connection with well-known phenomena."

The Best Speed-Time Curves in Rapid Transit.

Owing to the high output of the apparatus which may be put in their trucks, electrically driven cars or trains on private rights of way, where their speed is not interfered with by undeterminable obstructions, may be run on any one of a large number of speed cycles between stations. They may be started suddenly, run up to a high speed and allowed to drift or float into the next station; started rapidly up to a lower speed, maintained there until the next station is almost reached and suddenly stopped; or started slowly, brought up to a high speed and suddenly stopped. The relative merits of these alternatives have been discussed in the past, particularly by Messrs. W. B. Potter and A. H. Armstrong, who have shown that in general the first of the three methods is preferable. In a contribution concluded on other pages of this paper, Mr. J. R. Cravath discusses the amount of power taken to run a train between stations a given distance apart with certain assumptions as to the speed cycle, and the variations in this power required for varying schedule speeds.

It is unfortunately the case in rapid transit work that any short delay of a train is instantly followed by an increased accumulation of passengers waiting for it at the stations, so that to get back on schedule time the train must run at a faster rate than usual and that with longer stops at stations and a heavier live load. This triple increment of the duty necessitates a power equipment greatly in excess of that ordinarily needed. With a given acceleration and retardation maximum speed is attained between two stations by push-

ing the acceleration right up to the instant that the brakes must be applied to stop the train at the desired point. If a motor equipment is designed to do this in the emergency described above, it is best to obtain the lower schedule speed not by accelerating more slowly, as might be imagined, but by accelerating as rapidly as possible, loading the motors to their full capacity up to a speed considerably below that in the emergency work, and then allowing the train to drift or float with the power turned off until it becomes necessary to apply the brake.

While it is not always true with series-parallel control that it takes twice as much current to accelerate a train to a given speed with motors geared to run at 40 miles per hour as with motors geared to 20 miles, the advice to gear for low speeds and thereby gain leverage and tractive effort per ampere, is well worth following. As has been pointed out by Mr. Armstrong, the energy consumption in acceleration is reduced if the higher speeds run off the rheostat and on to the constant potential conditions across the motor terminals. This is the case in spite of the fact that the speed-time curve is badly bent over by the reduced amperage and reduced field strength of the motors, but might indeed be expected from the improved efficiency of motors so operated. The way to obtain it is to gear the motors for low speeds, so that resistance will only be needed part way up the acceleration slope. The best all-round conditions seem to be obtained by installing motors that will meet the emergency work with full power turned on until the brakes are applied, the acceleration curve rounding off as the motors run below saturation, but not necessarily falling to a flat or constant speed as assumed by Mr. Cravath. Schedule can then be maintained with runs of ordinary length by the same acceleration, up to a point well above the use of dead resistance and the beneficial drifting from that instant until the brakes must be applied.

The Resistivity Temperature-Coefficient of Copper.

The correct value of the temperature coefficient of resistivity in copper or, in common parlance, the rate of change in resistance with change in temperature of copper wires—is becoming of great and increasing importance to electrical engineers, for the reason that the temperature elevations of the copper conductors in electrical machines have commonly to be determined from their increments in resistance. The value usually employed is that found by Matthiessen in his classical researches upon the conductivity of metals and alloys in 1865. Matthiessen did not find a simple linear relation between the temperature and resistance in the copper wires he examined. The equation which represents his observations makes the resistance increase a little faster than the temperature, so that a curve of copper resistances as ordinates, with temperatures as abscissas, bends slightly upwards, or away from the axis of temperatures. Within the ordinary range of outdoor air-temperatures, however, the curve is approximately a straight line, representing a simple increase of resistivity at the rate of 0.388 per cent. per degree Centigrade, referred to the resistivity at 0° C. as standard.

Since the date of Matthiessen's researches, a number of different measurements of the temperature coefficient have been made in different countries and at different times, while a host of measurements of resistivities and conductivities have been made in commercial practice at definite standard temperatures. These measurements seem to show that the copper wires which are being commercially supplied and used to-day, frequently possess a higher conductivity; or, what is the same, a lower resistivity, than the best-conducting copper which Matthiessen was able to secure some thirty-five years ago, with all his skill as physicist and chemist. In other words, it is common to find commercial copper wires having a conductivity equal to that of Matthiessen's best, or standard copper—that is, 100 per cent. Matthiessen standard conductivity; while not infrequently, conductivities of 101 and 102 per cent. are reported. No confusion results from this condition of affairs, because electricians know that Matthiessen's standard is merely an arbitrary one, corresponding to a definite resistance in a soft copper wire one metre long and weighing one gramme—the metre-gramme; or, to a definite resistance between opposed faces in a cubical block of this copper, one centimetre in length of edge, and at the temperature of melting ice. There would probably be no great advantage in changing the standard conductivity in accordance with the highest results now attainable by physicists; because although the anomalous values of 101 or 102 per cent. would thereby be avoided, there would be, at the outset, a danger of confusion between the old standard and the new, and unless care was taken, it might be doubtful as to which standard was intended when the term "standard conductivity" was used. Thanks to the efforts of The American Institute of Electrical Engineers, a few years ago, the confusion as to what was meant by Matthiessen's standard has been cleared up, and the term has at present a perfectly definite meaning, as published in Volume X of its Transactions.

But the more modern researches have also shown a departure from Matthiessen's formula for the temperature-coefficient. A number of these researches seem to show that a linear or simple proportional relation seems to exist approximately, between resistance and temperature, for a considerable range in the latter, so that a curve of resistance when plotted to rectangular co-ordinates with respect to temperature is, apparently, a close approximation to a straight line. The inclination of this line with the axes indicates that the temperature-coefficient of copper is between 0.4 and 0.43 per cent. per degree Centigrade, referred to the resistivity of 0° C, some researches making the coefficient as low as 0.4, and others as high as 0.43. Looking at the matter in another way, an observer who measured the increase in resistance of a coil of copper wire, say in a dynamo armature, after it had become heated, might compute therefrom a temperature elevation of that coil which would differ—say to the extent of 5 per cent. or more—according to whether he used the ordinary Matthiessen formula, or a formula obtained from more recent observations.

This question of the temperature coefficient is, therefore, of considerable importance and deserves to be studied exhaustively. At first sight the settlement of the question appears to be very simple. All that has to be done is to measure the resistance of a copper wire at different temperatures in succession. Nevertheless, it is a measurement which requires considerable experimental skill in order to secure accuracy, owing to the difficulty of insuring that the temperature of the copper wire is really the same as that indicated by the thermometer which is placed in its vicinity. It is so easy to produce marked differences of temperature in a mass of fluid such as air or oil, and it is so difficult to obtain a uniform temperature distribution, that only by great care can reliable results be obtained. It seems, however, very important to collect as many reliable observations as possible on different samples of copper wire, and we notice that The American Institute of Electrical Engineers has called attention to this want in its circular on Co-operative Research which has been addressed to the various electro-technical laboratories of the country. It would seem very desirable to have this question of the correct temperature coefficient definitely settled by the next electrical Congress, and it is to be hoped that by the time that the Congress is convened, there may have been secured sufficient data to make this important numerical value definite, not merely for particular samples of very nearly pure copper, but also for samples of copper representing ordinary good commercial standards.

Municipal Street Railways for Detroit, Mich.

The agitation in favor of municipal street ownership of street railways in Detroit may be said to be at last successful, and all the preliminary votes and steps having been taken, the city may probably be able to acquire the properties at an early date from Mr. Tom Johnson and other owners. As finally signed, the McLeod law on the subject "authorizes the appointment by a majority of the Common Council, at any time within 20 years, of the Detroit Street Railway Commission, of three commissioners, appointed for two, four and six years respectively, their successors to be appointed by the Common Council on nomination of the mayor for six-year terms." It makes aldermen ineligible to appointment. It compels each commissioner to give a $250,000 surety bond for the faithful performance of duty. It makes the city treasurer custodian of all the commissioners' money. It gives the commission power to acquire, in its discretion, on any terms it deems advisable, by purchase, lease or otherwise, any street railway, wholly or partly in Detroit, including all unused franchises, and make needed extensions or improvements. It empowers the commission to operate roads so acquired for carrying both passengers and freight and manage them as it would a private business.

The Consolidation of Independent Telephone Manufacturing Interests.

Note has already been made in these columns of the reports current as to the proposed consolidation of leading interests in the "independent" telephone manufacturing field. It has been more or less of an open secret in electrical circles that plans of this character were suggested as far back as last August, but not until the present year did any actual work begin to show. The object of such a movement was obvious. Confronted by a well organized, well equipped, well officered and well entrenched foe, the independent concerns, if fighting among themselves, were at a double disadvantage, whereas if their efforts could be unified, their plants consolidated, and their product standardized, good reason could be found for hope of ultimate success, based on the universal public demand for cheaper telephony. This has been the argument or platform of those in favor of combination, and reports from that quarter now indicate reasons for believing that independent telephony is taking another move fraught with momentous consequences. Outside of the data given in these columns, almost everything has been pure conjecture, nor can all the facts be fully known until the leaders in the new enterprise choose to make a statement to the public. During the past week, Messrs. W. T. Blaine, of the Victor Telephone Company, and S. L. Bailey have been in the East engaged in the work of closing up deals necessary to the general plan of consolidation and they arrived in New York last Friday to take up the same programme in this city. Both gentlemen were willing to be interviewed on the subject, but very uncommunicative as to many important details. When their attention was called to the rumor current that the consolidation would be known as the American Independent Telephone Company with a capital of $7,000,000, half preferred and half common, issued to take up the various properties absorbed, Mr. W. T. Blaine remarked that those were details not one of which had yet been fixed. He said: "There has been a great deal of unauthentic, incorrect and misleading matter printed regarding the formation of the new independent telephone company. Many points are not yet decided, but the facts as far and as fast as they are ready for publication will be given out to the public through the ELECTRICAL WORLD AND ENGINEER which from time to time will have the news when it is a reality. The formation of the new company under the laws of New Jersey is an accomplished fact, and is proceeding as quickly as the legal requirements can be complied with. Those in charge of the matter have now over 20 options on manufacturing plants, Eastern and Western, that are deemed worth while; and they have also every element of lasting success in the control of apparatus of the highest electrical, scientific, and mechanical efficiency and perfection. They have also every element of success in the personnel of its officers, in the board of directors and in the abundant supply of capital."

Mr. Blaine refused to give the name of any officer, although it would be a safe inference from his manner that he will remain prominent in the enterprise. He continued:

"The new company will deal on broad and fair lines with the entire independent field, making no attempt whatever at despotism in control or at extortion in the sale of apparatus. It will serve all the exchanges that now exist or that are still to be established. There are over 2000 independent exchanges in the field, but they are at the furthest removed from standardization of apparatus, and one of the first steps, so desired by themselves, will be in that direction. Apparatus will be standardized. Construction also will be standardized and brought to the highest degree of efficiency. The new company will furnish such apparatus at moderate, reasonable prices to all or whomsoever may desire to purchase it. As intimated, it will also engage in construction work, of a standard guaranteed character. It will, with its ample resources, also assist in the development of the field wherever financial aid is needed, and will give its assistance, not only to the equipment of central exchanges, but the building of toll lines."

Mr. Blaine was asked as to the relations of the constituent, underlying companies in the consolidation to the independent exchanges now at work. He replied: "The new company considers that it now has from 85 to 95 per cent. of the independent telephone manufacturing business. Later disclosures will justify that figure fully. The firms included have been doing the work. There are some not as yet purchased. A fair and honest effort will be made to purchase them, but the remaining few, if of any account, we have not as yet tried to deal with."

"What is your attitude towards the Bell system?" was asked.

"This new company has not been organized," said Mr. Blaine very emphatically, "to fight the American Bell Telephone Company or any other company. It will mind its own business. It believes that, as in other lines, the independent telephone field offers a splendid opportunity for dignified, regular and permanent enterprise and investment, in the fitting up of exchanges able to give such service as the independent exchanges have never known before. It will enter the broad domain, and supply the demand, from the manufacturing of all classes of apparatus needed in the work to the equipment and ownership of exchanges and of toll lines. Whoever wants to buy telephones of us can get them outright. There will be no royalties, but all dealings will be on a straight, direct manufacturing basis."

Mr. Blaine declined to say whether the rumors were correct which intimated that the company would have two or three territorial factories, one East, one in Chicago and one in the far West. He suggested that it would, at least, be necessary for sometime to carry on present plants. The plan of handling the goods he declined to discuss. As to the type of exchange—"central energy," battery at subscriber's station, etc.—he had no data to give out. He said that the company would be in a position to command the best telephonic talent in the country, and that the independent exchanges would get the prompt benefit of all improvements. Returning to the present status of the effort at combination Mr. Blaine refused to give any list, and satisfied himself with remarking that it would be more or less of a surprise when given out.

"The new company has never yet given out a list of the options it holds," he said, "but immediately upon the completion of the organization a full prospectus will be furnished, together with the capitalization, the officers, etc. The company, let me say meantime through the ELECTRICAL WORLD AND ENGINEER, is not a trust. It is not a combination. You can hardly call it a consolidation. It will make no attempt at a monopoly. But it will try to find favor with the millions of users and purchasers of telephone apparatus, upon substantial, commercial lines, with the motto "good goods and honest values." The independent telephone exchanges are to be congratulated upon the standardized character of the apparatus that will now be offered them and the manner in which the new company will deal with everyone interested in this remarkable field of industrial effort. There will be available uniform apparatus, uniform service, and increased efficiency, and every exchange will be saved a great deal of money each year."

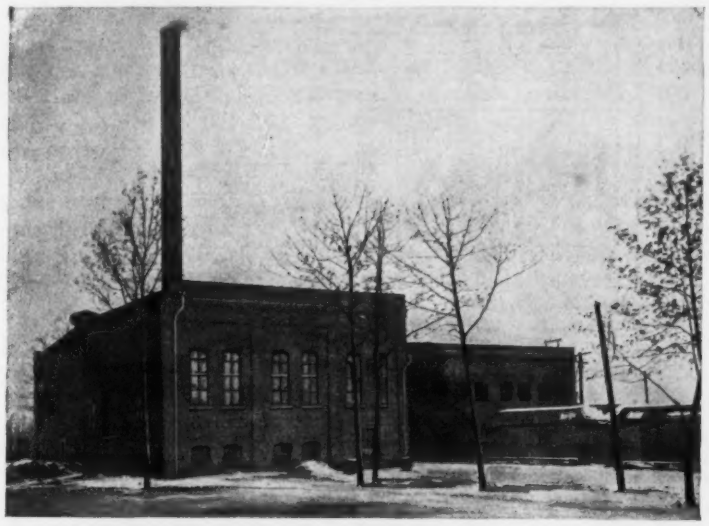
From the west it is reported that the leading "firm options" have been given by the American Telephone, Sterling, Western Telephone and Victor Telephone Companies. The Laclede Battery Company, of Kokomo, admits having granted an option. The Holtzer-Cabot Company in Boston has entered into no agreement and given no option. In New York, J. H. Bunnell & Co. have made no deal, but De Veau & Co. and Stanley & Patterson make no effort to deny their willingness to aid in the movement. The majority of the concerns are very reticent on the subject and speak of it as a matter entirely personal to themselves, and of a private nature.

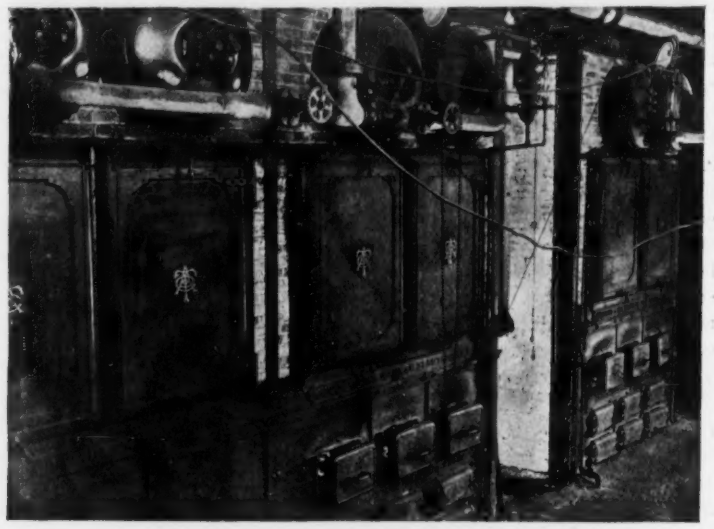
Chicago and Milwaukee Three-Phase Electric Railway.

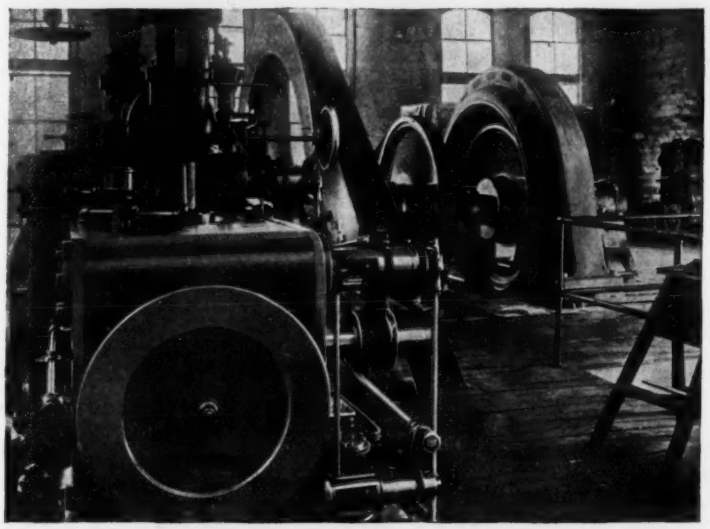
By S. S. Sherman.

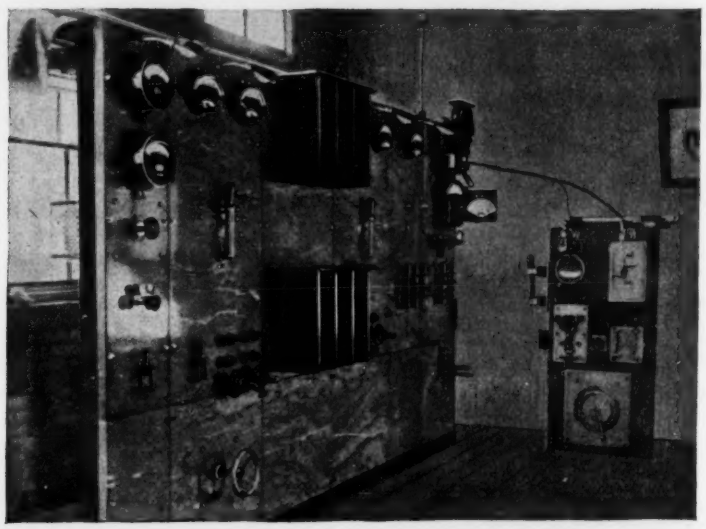
WITHIN the last two weeks the new Chicago & Milwaukee Electric Railway has come into existence. The old Chicago & Milwaukee line, if a street railway begun less than three years ago can be called old, has reached the end of its career, and is now in a process of metamorphosis which will result by July 1 in producing the finished new road. The new Chicago & Milwaukee Electric Railway, moreover, is expected to inaugurate an era in interurban railways.

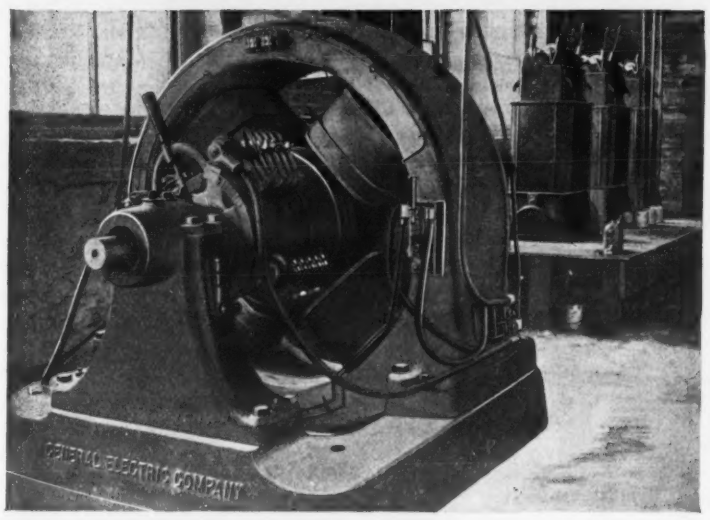
The old line is believed by its designer to have been the pioneer in its own peculiar class. In this class, the electric current to run the cars over a long line is generated at a central steam power house. It is transmitted as a three-phase alternating current of high potential to substations, where step-down transformers and rotary converters change it to a continuous current suitable for the trolley wire. A road of this kind was recently described in The Electrical World, but it obtained its power from a waterfall and used











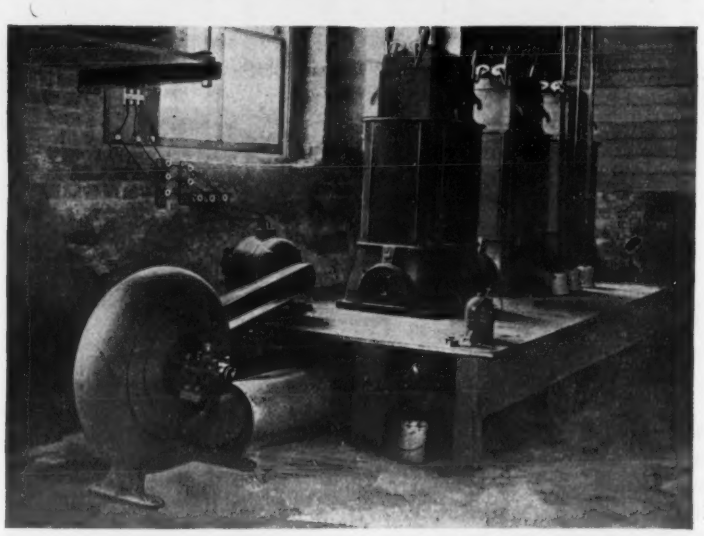


Fig. 1.—Power House.
Fig. 2.—Engine Room.
Fig. 3.—Substation in Power House.
Fig. 4.—Boiler Room.
Fig. 5.—Switchboard.
Fig. 6.—Transformers in Power House Substation.

Chicago & Milwaukee Electric Railway.

but one substation. It is believed the old Chicago & Milwaukee line was the first to make the attempt to operate in this way from a steam plant.

This is the old road's claim to fame. Its power house was only partially built and incompletely furnished with machinery. Its road was laid most of the distance with but a single track. Its single substation was equipped with temporary constructions. It probably did not run as economically as it might; but it was the first—and a success. The new road, however, promises much more. It will be a model installation. Power house, machinery, substation, track and rolling stock will all be in the latest style of the art. More than all, the new road, operating under the three-phase transmission plan, is guaranteed by its contractors to show an efficiency that will prove the success of the new type of long distance electric railroads.

The consulting engineer of the Chicago & Milwaukee line is Mr. B. J. Arnold, of Chicago. Nearly four years ago, in making plans for the Wisconsin and Inland Lakes railway—a line 85 miles long, planned to connect the summer resorts of Wisconsin—Mr. Arnold conceived the idea and drew up plans and specifications for a three-phase and direct-current electric road. When a year later he was employed to lay down the design, he merely adapted his scheme to the new conditions. A portion of the road has been running for nine months in an incomplete state. A short time ago the company was reorganized and capital secured to finish the work The plans were revised and enlarged and new features embodied. During the last two weeks the contracts for the work have been let to the Arnold Electric Power Station Company, and construction has already begun, and the work is to be finished by July 1. In order to give a clear idea of what the railway will be by that date, it is necessary to first describe the old road as it existed before changes were begun—which is practically, as it exists to-day.

The Chicago & Milwaukee Electric Railway, as now in operation, consists of a double and single track line extending from the south limits of Highland Park, to the north limits of Waukegan, a distance of 18 miles. It passes through the city of Highland Park, the towns of Highwood, Fort Sheridan, Lake Forest, Lake Bluff and North Chicago and the city of Waukegan. The route throughout parallels the steam line of the Chicago and Northwestern Railroad and the shore of Lake Michigan, between which it runs. At Fort Sheridan is the government reservation and military post. There are manufacturing interests at North Chicago and Waukegan. The other places are almost exclusively residence suburbs of Chicago.

Aiming to make this line, with a probable addition of 13 miles south and to Milwaukee north a total distance of nearly 90 miles, into a first-class high-speed electric railway capable of competing with the steam road nearby, it was necessary to devise a transmission system which would operate with economy and would permit eventual additions as the length of the line and the amount of traffic increased. The great cost of copper for the feeders prevented equipping the road with a direct-current system supplied from a central power house. Two or more separate power houses, or one with a booster system, would not give a good efficiency. After going into the subject thoroughly, Mr. Arnold finally adopted the plan he had previously worked out for the Wisconsin and Inland Lakes railway, and which was thought to solve the problem presented.

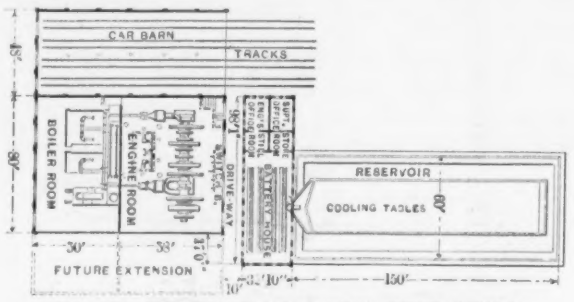
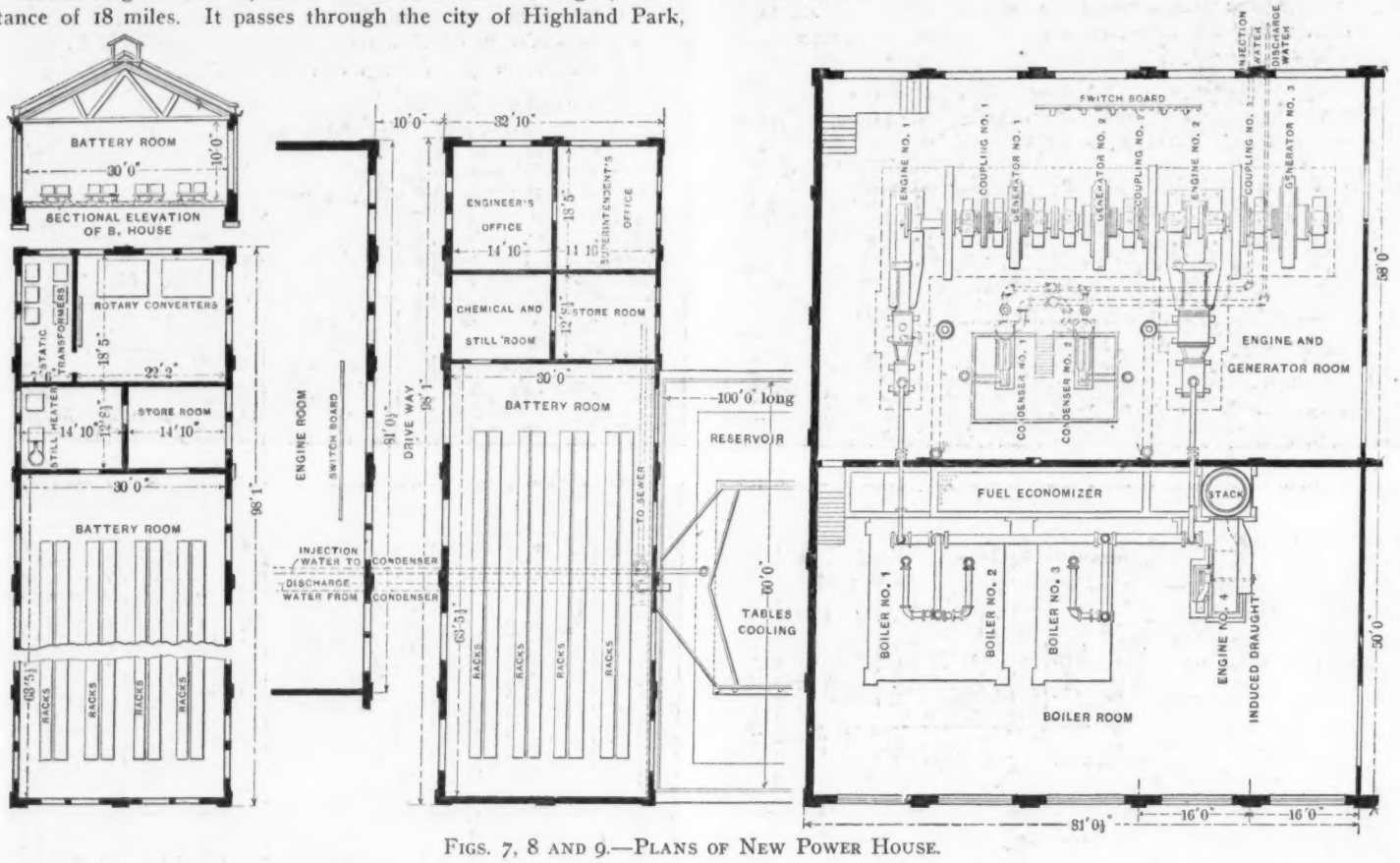


FIG. 10.—GENERAL PLAN OF NEW POWER HOUSE.

Pretty well to the south end of the present line near Highwood, is located the power house. It is just off from the route of the road, with a switch track from the Chicago and Northwestern railroad running to the rear. At the town of North Chicago, near the north end of the line, is located the single substation, though a temporary substation has been made in the basement of the power house building itself. The main car barns and repair shop are just to the north and under the same roof with the power house. A temporary shelter for cars has been provided at North Chicago also.



FIGS. 7, 8 AND 9.—PLANS OF NEW POWER HOUSE.

The section of the road near the power house is mainly supplied by direct-current at 600 volts pressure from a temporarily direct-current dynamo in the power house and from the rotary converter and a part of the substation apparatus intended eventually for the southern substation, thus making a temporary substation in the basement of the power house. This and the substation at North Chicago are supplied with three-phase currents at 5500 volts from

an alternating dynamo in the power house. The currents are passed through step-down transformers and then at a pressure of 380 volts into the rotary converters. From the commutator sides of these machines direct-current is sent out at 600 volts to the trolley wires. The substation at North Chicago thus supplies the north end of the line, while that in the basement of the power house helps out the direct-current dynamo doing the same work.

The track is laid with 65 and 72-lb. rails of the "T" and "Shanghai" sections, and also 85-lb. girder rails, all in 60-foot lengths. The ties are of oak, spaced 24 inches between centres. The "Protected" rail bond of No. 0000 size is used, with fish plates having eight bolts in two rows.

In the business centre of each town iron centre poles are used. They are 30 feet long, in sections 5, 6 and 7 inches in diameter. For the other parts of the line cedar side poles are used. These poles are 30 feet long and 7 inches in diameter at the top. The span wires are of 5-16 inch galvanized iron wire and the trolley wire of No. 00, B. & S. gauge.

The high potential transmission line is carried on the trolley poles on wooden cross arms. It consists of three No. 8 bare copper wires, strung on double petticoated insulators mounted on wooden pins. All poles carrying these wires are stencilled with a danger notice. Several No. 0000 and No. 000 feeder cables run from the substation and power house to the overhead trolley wire. These are also carried on the poles.

The power house is built of brick, with a steel stack and steel roof beams. The building is 108 feet deep and 55 feet wide, a temporary wooden bulkhead forming the south wall and permitting an easy increase in the size. The car barn, to the north, is 108 feet by 48 feet in size. Both are one-story buildings, though there is a basement under the engine room in the power house.

The boilers are of the Cahall, Babcock and Wilcox water tube type, fitted with Hawley down-draft furnaces. One pair and a single boiler are now in place, each rated at 250-hp. The setting is such that the boilers are entirely independent of the brickwork that surrounds them. The coal used is thrown directly into the boiler room from cars on a side track running from the Chicago & Northwestern Railroad along the west side of the building. A coal shed of temporary construction has also been provided nearby for emergencies, and water is obtained directly from the Highwood mains and supplied to the boilers by Deane feed pumps.

The engine room is half a story higher than the boiler room, in order to provide space for foundations. One 400-hp engine is installed at present. It is a horizontal side crank Corliss engine, made by the Filer & Stowell Company, of Milwaukee. The fly wheel weighs 40,000 lbs., and is 14 feet in diameter. The governor of the engine is of the Powell inverted type, and is fitted with automatic safety stops to prevent the engine running away. This stop blocks the governor balls up, except in the event of the governor belt breaking, and the device is arranged so as not to need handling at the starting or stopping of the machinery. The engine is compound condensing, but is run at present non-condensing, owing to the absence of a cooling tower or pond.

The unique features of the power station are the electrical equipment and its arrangement. Two different types of generators are employed. The generator mounted next to the engine and directly connected with it is an alternating three-phase revolving field General Electric machine with a capacity of 250-kw at 125 r. p. m. This generator has 24 poles, and, therefore, delivers its three-phase current at 25 cycles per second. The current is generated at a potential of 5500 volts, and is intended for transmission direct to the substations without the use of transformers. At present this dynamo is amply able to take care of the substation at North Chicago, and some of the excess of current is used (through the substation in the basement of the power house) on the line near the generating plant.

The other temporary generator was originally intended to supply either direct or three-phase currents, as desired. It is a rotary converter fitted with a pulley driven by a belt from the fly wheel, and has brushes on either end of the armature. The direct-current is given out at 600 volts for use on the trolley wire, while the alternating currents are at 380 volts. The machine was first fitted with transformers, which raised the alternating pressure to 5500 volts and supplied the substation prior to the installation of the direct connected three-phase generator. Later its entire output was needed in direct-current, and the dynamo is now run exclusively as a direct-current machine, but will be discarded entirely when the additional machinery is installed. A small direct-current exciter for the alternator completes the dynamo batteries installation, which will also be discarded where the batteries in the power house are installed.

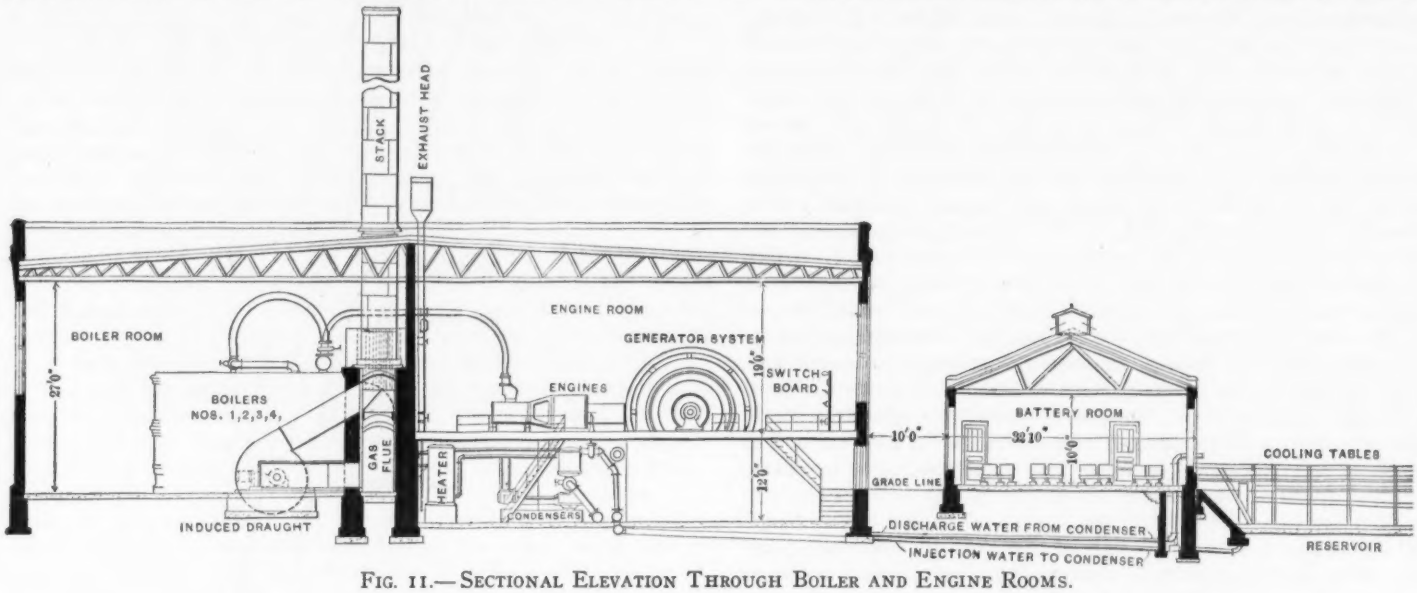


Fig. 11.—Sectional Elevation Through Boiler and Engine Rooms.

The switchboard is of marble on angle irons, and is located in one corner of the engine room. It has recently been constructed, and is still supplemented by a temporary board which provides controlling instruments for the direct-current generator. In the main switchboard there are six panels. The left hand is the exciter panel, the next controls the big alternator. The converters for the temporary substation in the basement are on the third. No. 4 holds the switches for the three-phase line to the substation. The last two panels are used for the rotary converter in the basement, one for the alternating end and one for the direct-current end of the machine. Thomson recording wattmeters, Thomson-Houston alternating voltmeters, Weston direct-current instruments and General Electric circuit breakers and switches are used. Oil-break switches are used for the high voltage alternating currents.

The substation at North Chicago and the one in the basement of the power house are practically the same as far as machinery is concerned. They each consist merely of three static transformers and a rotary converter, with a suitable switchboard. The switchboard for the power house substation, as stated, is part of the main engine room switchboard at present. The transformers are each of 42-kw capacity. General Electric type, with a primary voltage of 5500 and a secondary voltage of 380. They are kept cool by a small blower with an air pressure of ¼ oz. run by a 1-hp induction motor. The rotary converters are of the well-known General Electric type. The speed is 750 revolutions a minute. The continuous current capacity is 125-kw, voltage 600. The alternating currents are received at 380 volts, 25 cycles a second.

The rolling stock of the road is partly old and partly new. Four cars of the ordinary city pattern, built by J. G. Brill & Co., were first in use. Ten new 32-foot cars made by the St. Louis Car Company are more recent on the road. But the feature of the rolling stock is furnished by two new coaches recently completed by the Pullman Company for the line. They are vestibuled cars of the convertible type, both for winter and summer use, and built to be operated at high speed. The cars are 38 feet over all and mounted on Peckham and Brill standard double trucks, equipped with two 50-hp motors. The passenger coaches have seating capacity for 40, while the combination passenger, express and baggage cars will seat 36 passengers, besides having a compartment for express and baggage. The cars are finished in solid cherry with bird's eye maple ceiling and handsomely decorated, and furnished with reversible rattan seats. The equipment is painted a royal blue with gold lettering, and the road will be known as the "Royal Blue Line." Several snow plows, one of them a rotary, a scraper and a construction train complete the rolling stock.

This is the old Chicago & Milwaukee Electric Railway. It has been operating throughout last summer, and the recent winter, and has earned a fair per cent. on its original investment. But it will be far outshone by the new line now in process of growth. The following changes and additions will be made:

In the first place, the route of the new road will be 31 miles long, an addition of 12 miles of double track on the south end. It will run then from the City of Evanston to the City of Waukegan, and will be double tracked from Evanston to Highwood, or about two-thirds of the length. To the old route will be added the towns of North Evanston, Wilmette, Kenilworth, Winnetka, Lakeside, Glencoe and Ravinia. A good connection with the lines running into Chicago from Evanston is assured, and at the other end a connecting electric railway will run from Waukegan to Milwaukee. This latter line is already completed from Milwaukee to Kenosha, and only has ten miles further to be built. When the system is complete it will be possible to travel by electric car from Milwaukee, Wis., to Hammond, Ind., a distance of a little over 100 miles.

The new line will have a substation between Kenilworth and Winnetka, in addition to the present substation at North Chicago, which will be remodelled. The present substation apparatus in the basement of the power house will be moved to the new substation and added to. The power house will be greatly enlarged and more machinery added. A number of clever special features will be provided.

The new roadway is to be built of the same construction as before, using the heavier rails almost exclusively. The overhead work will be principally of side pole construction, and the new three-phase high voltage transmission line cared for as in the present case. When done the track work is expected to be up to the latest standards set by the art.

At the power house most important additions and developments of the present installation are contemplated. The building itself will be increased to 80 feet in length. This will be easily done by removing the wooden side now on it, and extending the brick walls and iron roof. Another extension if needed is provided for. An office and storage battery building will be constructed directly in front, separated only by a driveway. Beyond that still, large cooling tables and a reservoir will be built.

A fuel economizer, with all necessary scraping and driving devices of the Greene type, is also included in the specifications. This will be of sufficient capacity to handle all the feed water used when the road is operating at its full capacity, and will deliver it at a temperature of 275° F.

A mechanical draught fan and its engine will also be placed in the boiler room. This will be of a size sufficient to produce a draught of one inch of water in the base of the stack when the plant is operating at the full working capacity. This and the economizer will be so arranged that the gases from the boilers may be delivered either directly into the stack through the economizer or not, or through the mechanical draught fan.

The engine room will contain, when finished, two engines and three dynamos. The second engine will be a centre crank. Filer & Stowell horizontal Corliss tandem compound condensing designed especially for the case. It will be of a rated capacity sufficient to drive with maximum economy two 250-kw generators at their full rated capacity, and will yet provide for an overload capacity sufficient to handle all three 250-kw generators.

Two Deane jet condensers, of which there is now one in the plant, but not in use, will be installed. They will connect with the cooling table and pond and will be of sufficient size to handle the exhaust steam when the plant is running in full load. They will be put in the basement under the engine room. Pumps and piping are also included in the specifications.

The present alternating current generator will be left in its place. Another of same type will be added and a direct-current generator of sufficient direct capacity to handle the load of the section of line next to the power house. These machines and the two engines will all be in line, being connected by the Arnold system. By this system each generator is mounted on a quill or hollow shaft, with a solid shaft inside. Magnetic clutches, worked from the switchboard, connect the solid shaft with either the hollow quills or the engine shafts at will. In this way, generators No. 1 No. 2 may be operated by either of the engines, while engine No. 2 may run the three generators if necessary.

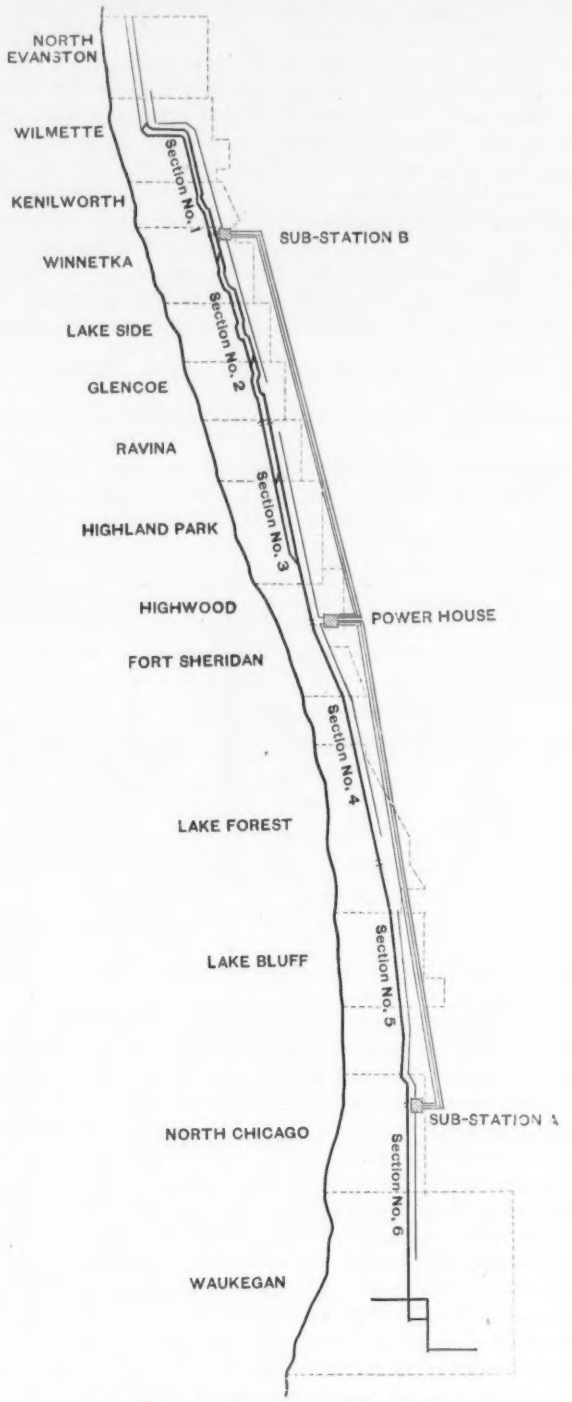


FIG. 12.—DIAGRAM OF FEEDER SYSTEM.

This system provides for a break down without the necessity of a reserve unit. It is particularly adapted to a station of the present character, which contains two different types of generators. When the load is light the road may be operated from the small engine by coupling it to generators Nos. 1 and 2. As the load increases,

engine No. 2 can be started and generator No. 2 transferred to it and the other machine or generator No. 3 thrown on. Since the generators are mounted on independent bearings, it is possible to operate the direct-current and alternating current generators coupled together as a rotary converter, should need arise; and as all the engines and generators can be coupled together mechanically, if desired, perfect synchronism of the alternating generators is assured when working in parallel, regardless of the fluctuations of engine speeds.

The magnetic clutch, which is to be used as a convenience in this plant, consists of two large friction discs provided with magnets and mounted on a third in such a way that any combination of adhering surfaces desired may be secured. By means of proper electrical connections and a small amount of current (less than an ampere) a clutch will serve as a coupling of a dynamo with either an engine or another dynamo. A great saving in labor of engine tenders and a great gain in convenience is accomplished by it, at practically negligible expense.

The present switchboard will be extended farther south into the new portion of the engine room to be built. It will contain suitable switches and instruments for the additional generators to be installed, the magnetic clutches and the battery. Its general type will be the same as at present.

In front of the power station and separated from it by a driveway will be built the battery house and offices. The building will be 98x33 feet, 64 feet of its length being taken up by the battery room, and the rest devoted to the offices and store rooms. A storage plant of the latest make of the Electric Storage Battery Company will be installed in glass jars mounted on racks. This battery will have sufficient capacity to equalize the direct-current load of the power house, and to run the section of the road next to the power house for some time if necessary.

In front of the power house a large excavation has been made for a cooling table. This will be increased to 150x160 feet in size and a table and reservoir installed of sufficient capacity to cool the requisite amount of water to allow the condensers to maintain a 22 to 25-inch vacuum in the engine cylinders at full load.

Two new substation buildings are to be erected. One will take the place of the temporary structure at North Chicago, and will have the present apparatus there installed in it. It will also provide for a storage battery of a size sufficient to run the north section of the road for some time unassisted. The second substation will resemble the first closely, but will have double the capacity. The rotary converter and transformers now in the power house will be taken to this new building and duplicates of them provided in addition. The storage battery at this point will also be larger than that at North Chicago.

To provide against breakdowns at the substations, Mr. Arnold has hit on a novel scheme. He will have a rotary converter, transformers and a switchboard mounted on a car fitted with its own motors, so that it can run out to any part of the line on a few minutes' notice. Connecting wires and plugs will be provided and sockets will be put in the substation switchboards. This car will, therefore, be a movable substation. When a break-down at a substation occurs the storage batteries will be relied on to run the section in trouble until the portable substation arrives, when the plug connections will be made and the converter set to work. After repairs are concluded the portable substation will run back to its resting place in the car barns. This portable substation can also be used to help out congested portions of the road on days of heavy traffic.

The equipment for the new line will consist of the cars already in use and an important addition. The latter will be ten new "Royal Blue" interurban cars of the type of those recently built for the road by the Pullman Company. Additional snow plows and sweepers will also be provided. The car barns north of the power house will be fitted with better repair facilities and additional shelter for the cars arranged for.

This is, in outline, what the new Chicago & Milwaukee line will be. So confident of its success is Mr. Arnold, that his company in making the contract has given a guarantee of efficiency in operation. With everything completed and full complement of heavy trains running, the contractors guarantee that a certain per cent. of efficiency in operation will be reached.

The Chicago and Milwaukee Electric Railway Company was originally the Bluff City Electric Street Railway Company, and was organized and built by C. E. Loss, as owner and contractor. It sold out to the North Shore Interurban Railway Company, which in turn was succeeded by the present owners. The officers of the existing company are: President, George A. Ball; vice-president, A. C. Frost; treasurer, J. W. Mauck; secretary, George M. Seward; superintendent, R. S. Ives.

The Value of Electric Brakes as Recuperating Devices for Automobiles.

By F. B. Booth.

THE question of the heightened efficiency in any application of energy to the accomplishment of useful work always possesses an especial interest for the engineer, and exercises his ingenuity in efforts to usefully apply every foot-pound of available work and reduce the unnecessary expenditure to a minimum. If this is profitable and interesting with ordinary electric generating and translating devices it is doubly essential in the case of electric vehicles where the store of available power is limited, and any increased efficiency in operation results not alone in a more economical machine, but in a greater radius of action and a wider sphere of usefulness as well. It is then with an enthusiasm perhaps only natural that a first or superficial consideration of the question of checking the momentum of a heavily loaded automobile on grades or at high speeds leads one to believe that the advantage is considerable when this necessary operation is effected by running the motor as a dynamo under the impulse of the vehicle, and recuperating the batteries with a reverse current thus generated, effecting the braking action by the magnetic drag upon the armature.

Experience, however, and a due regard for the principles involved, leads to the belief that the two functions of braking and recuperation deserve quiet separate treatment, and the attempt to combine them yields a recuperating device of less practical benefit than popularly supposed, and a brake which possesses the serious objection of transmitting all the retarding force through one or more changes of gearing before it is applied at the wheels. In France this method of braking has been widely used, but of late generally abandoned, mainly because even experienced operators found it difficult to entirely avoid the stripping of gear teeth. The best form of electric brake seems to be one in which a mechanical shoe is applied by an electromagnet energized by current from the motor run as a dynamo or by current supplied by the battery as the speed decreases. This relieves the gearing of the excessive strain, and can be made quite effective, but does not, of course, provide for any return of power to the batteries, and ceases to interest us as a recuperating device.

The only logical and practical way of using the charging combination is by prohibiting its use altogether as an emergency brake—that is to say, as a means of effecting sudden stops or retardations—and permitting only of its gentle application on steep down grades, accepting its retarding qualities as a incident in the process, valuable in so far as they render temporarily unnecessary the tiresome application of a mechanical brake, the presence of which, however, must always be relied upon to perform the ordinary braking functions. But even with these limits, the question may be asked if a recuperating device is of sufficient practical value as measured by the increased radius of action affected, to offset the additional expense and complications involved, as well as the possibility of abuse in inexperienced hands.

To arrive at some approximate idea as to the amount of power returned to the batteries under favorable conditions, let us consider a vehicle of 2000 pounds, with a motor and connections which permit of charging on down grades. A draw bar pull of 25 pounds per 1000 may be allowed for a pneumatic tired carriage of this weight upon a good hard level road for moderate speeds. It would probably be desirable to reduce the speed of this vehicle to nearly five miles per hour, or 7.33 feet per second, when descending grades At this speed on a level, 7.33x50, or 367-foot pounds per second would be required at the wheel rims. To place the possibilities of the charging brake in the most favorable light, we may assume a gearing efficiency of 95 per cent. and a combined efficiency in the wiring and the motor of 80 per cent. or a total of 76 per cent., and will further assume that these efficiencies hold under all the varying loads to be considered. To maintain the speed of the vehicle, then, under the above conditions, a battery expenditure of 367 ÷ .76 or 483-foot pounds per second, would be requisite on a level course. The effect of a grade is to add its gravity component to the drawbar

pull on the level, and in the case of a 5 per cent. grade this would be increased from 50 to 150 pounds, calling for a battery expenditure of 150x7.33 ÷ .76, or 1447-foot pounds per second.

In the descent of this same 5 per cent. grade, gravity exerts a pull of 100 pounds, 50 pounds in excess of what is necessary to maintain the 5-mile an hour speed. An efficiency of 70 per cent. may be considered fair for a small carriage motor operating as a dynamo through the employment of some special shunt winding, and is much higher than could be obtained as an average for the widely varying loads to be applied. Assuming this efficiency for the motor and wiring, or a total vehicle efficiency of 66.5 per cent., the power which may be returned to the batteries becomes 50x7.33x66.5, or 243-foot pounds per second.

Under the above assumptions, then, which plainly impose upon the operation of a charging brake ideal conditions which can only be approximated in practice within a limited range of gradients, the vehicle employs a power of 1447-foot pounds per second in ascending a 5 per cent. grade, and recovers but 243-foot pounds per second or 17 per cent. of the original expenditure in descent. Further, it may be seen that this return is capable of propelling the vehicle for a level distance equal to 50 per cent. of the length of the gradient descended.

The maximum percentage of return under the above assumptions for grades likely to be encountered is shown in the diagram. Curve *A* represents the percentage of power expended in ascending a

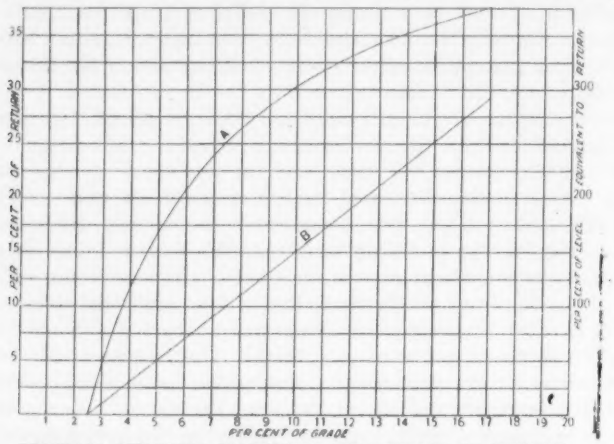


DIAGRAM SHOWING MAXIMUM PERCENTAGE OF RETURN.

certain grade that could be returned to the batteries were the same grade descended. Curve *B* represents the level distance over which the vehicle might be propelled by the energy thus returned, expressed in per cent. of the grade length. At a 2½ per cent. grade the gravity component just equals the amount necessary to maintain motion; on lesser grades the carriage is incapable of coasting.

It is apparent that the true value of the process rests wholly with the conditions under which the vehicle is used. An inspection of curve *A* shows that this device is practically valueless for service which does not involve grades of more than 5 or 6 per cent., while a consideration of curve *B* indicates that even the heavier grades must be of considerable length to make any appreciable addition to the store of battery power. A 10 per cent. grade 400 feet in length may add 600 feet to the level mileage, but the ascent of this grade requires five times the power for a similar distance on the level, in addition to working the batteries at a low rate of efficiency, and as the ordinary cycle of operations requires that any grade descended must be again ascended, it is apparent that the conditions which grant practical utility to the charging brake at the same time decrease the general efficiency and range of the vehicle in a ratio so much greater, that the recuperation afforded sinks into comparative insignificance.

For carriages to be used in unusually hilly districts in cases where the convenient and aesthetic features of electricity recommend its adoption, in spite of its weight and diminished mileage, recuperation may assume an important aspect and be applied with good effect; but owing to the rarity of grades exceeding 8 per cent. in city and suburban streets, it seems unlikely that this feature will ever play any important part in the equipment of vehicles built for this service.

Municipal Gas Plant Sold.

Findlay, O., has sold its municipal natural gas plant to the Citizens' Gas Light and Heating Company for $150,000, after operation for 12 years. The original cost was $300,000.

Experiments with the Wehnelt Interrupter.

BY GEORGE T. HANCHETT.

SINCE the joint communication with Mr. Charles T. Child on this subject, published in these columns on March 25 last, the writer has made some further experiments and has obtained results an account of which may be of interest. The curious sucking sound which the interrupter makes after it has suddenly stopped, and the current is cut off from the outside, remained a puzzle for some time, until on one occasion, when no switch was conveniently at hand, the circuit was broken by lifting the anode from the electrolyte. The reason for the sucking sound and also for the stopping was at once apparent. On lifting the anode from the electrolyte, the liquid still adhering to the point of the interrupter began to boil, indicating that the apparatus was very hot. By allowing it to cool sufficiently and putting it back into the electrolyte it would start again, stopping abruptly when its temperature increased. If placed in the liquid before it had an opportunity to become cool, it refused to work. This seemed to the writer to be ample proof that overheating was the primary cause of the stoppage and that the peculiar sound emitted when current was cut off at such times was due to the cooling of the heated platinum point in the electrolyte, which was prevented by a thin film of bubbles from coming in contact with the point while the pressure was on, the bubbles being con-

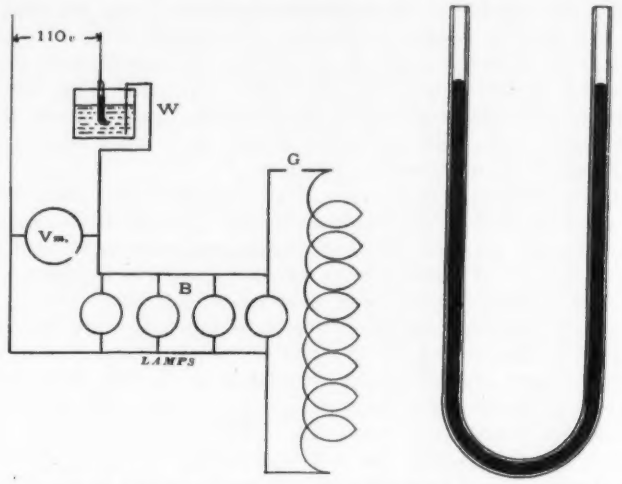


FIG. 1.—DIAGRAM OF CONNECTIONS. FIG. 2.—MECHANICAL ANALOGY OF INDUCTIVE CIRCUIT.

tinuously maintained by the slight current flowing. The creeping action of the current in the glass joint, which was noted by the writer, and which has also been observed by others, is also explained by the fact that the exposed surface cannot become a path for the current on account of the closely adhering gaseous vapor around the point; therefore the current had to seek new paths, flowing in relatively large volume from the point between the glass and platinum. This also explains the destructive action of currents on the Wehnelt interrupter at times of static condition. The current flowing from points close to or even under the joint heats the latter very rapidly, expanding it and cracking the glass. The pinkish glow which has been referred to is simply red hot metal.

In making experiments with inductances and capacities in combination with the new interrupter, the writer developed several curious results, two of which are worthy of mention. A circuit was connected as in Fig. 1. *B* represented a bank of lamps, and *W* a Wehnelt interrupter. The interrupter seemed to have a practically negligible resistance and short circuiting it did not appreciably brighten the lamps. The interrupter did not act, but simply allowed the current to pass continuously and quietly. This, undoubtedly, was due to the fact that in the first place the current was not large and in the second place, the self-induction of the circuit as a whole was very small. The lamps were then short-circuited by a wire some 20 feet long of No. 14 B. & S. gauge, wound tightly on a straight core of soft iron wires. The effect of this was to start the interrupter violently, the voltmeter needle fell to zero, and the lamps instead of being extinguished glowed with intense brilliancy, to produce which would require an electric pressure at their terminals of no less than 200 volts. The reason of this phenomenon is evident. The voltage which caused the lamps to glow so brilliantly was of an alternating character, hence the direct-reading voltmeter for con-

tinuous currents could not indicate it. The coil with its circuit of incandescent lamps constituted a local loop in which were circulating alternating currents of high frequency, which were undoubtedly some function of the frequency of the interrupter. The action can be explained by a simple mechanical analogy illustrated in Fig 2. A U-shaped tube containing mercury is shown diagrammatically. It is well known that if air be blown into such a tube in one end, in well timed puffs, the mercury will oscillate back and forth in increasing amplitude. Similarly, in the electric circuit described there were regularly timed impulses of e. m. f. to which the inductive and non-inductive branches of the loop responded.

The effect varied widely with the inductance used, and a coil wound on a closed magnetic circuit seemed to fail to produce the action, the lamps dying out as if short circuited by a substantially non-inductive resistance. This the writer ventures to attribute to the failure of the sluggish closed magnetic circuit to respond to the high frequency. That alternating impulses of high frequency were generated in this circuit was demonstrated in a rather interesting manner. The inductive circuit was opened at *G*, thereby allowing an arc to form. With a little care this arc became continuous and gradually melted away the terminals. As it became longer it emitted a humming or purring sound of the same pitch as that of the interrupter, and as it was attenuated almost to the point of breaking, it became marked with beautiful striations. It was intensely hot and melted the heavy copper terminals very rapidly. By opening and closing this circuit before the inductive action had time to get well established the slight arc due to direct currents was so small that it might easily have been broken with an ordinary lamp socket switch; whereas the arc due to the alternating oscillations was so highly califoric that it would have easily destroyed such a socket switch. The inductive and non-inductive resistance required considerable adjustment before maximum results could be obtained.

Among the various theories which have been advanced to explain the action of the interrupter, the writer ventures to propose one, which, if not his own, has at least been independently arrived at. It is as follows:

With moderate voltages, when there is no interrupter action, the action is simply electrolytic, producing hydrogen at the lead cathode and oxygen at the platinum anode. As the voltage rises and more current flows, the action becomes more and more energetic and finally when the apparatus begins to interrupt, the violence of the action is explosive. A bubble of oxygen is almost instantly formed at the platinum point and is projected therefrom with explosive violence, allowing the platinum point to find the electrolyte again and repeat the operation. That there is a good deal of nascent oxygen present at the anode is evident by its destructive action on organic substances, such as fibre and similar compounds, which the writer has used for insulating tubes. The fact that the anode emits streams of bubbles which literally bombard adjacent surfaces seems to prove that there is no reunion of gases, but that the latter are thrown off. The action is undoubtedly enhanced by the stripping effect which Prof. Thomson has alluded to, namely, that the bubble once formed reduces the area of contact and increases the current density, completing the action by surrounding the platinum point with gas with infinite rapidity. To the writer there seems to be no reason why a theory of even moderate complication should be evolved until the more simple ones proposed are disproved, especially since facts seem to be in accordance with the simple theory.

An effort was made to construct a very large interrupter capable of passing heavy currents, by preparing a metal plate with a number of prongs of platinum. This plate was connected with a thoroughly insulated wire and covered with hot sealing wax until only the points of the platinum prongs protruded. Unfortunately, however, the life of this interrupter was extremely short, for the nascent oxygen attacked the sealing wax, forming a little crater at each point, which soon assumed such large dimensions that the interrupter ceased to work. If a suitable fluid insulating substance could be found, which would not combine with nascent oxygen and which was heavier than dilute acid, an interrupter could be constructed on this plan which would work well, since it would be practically indestructible and self-restoring.

Electric Light Plant for the State Capitol.

The bill appropriating $60,000 for the establishment of an electric lighting plant in the Capitol, at Albany, was adopted in the senate last week by a vote of 29 to 20.

The Cost of Speed in Rapid Transit Service.—II.

By J. R. Cravath.

In the previous article speed curves were given for multiple unit and single motor car trains for schedules of from 14.2 to 23.7 miles per hour, with stations 2000 feet apart, and these curves should be consulted in connection with those given in this article.

The speed curves having been plotted for the various schedules and equipments, we will attempt to determine approximately the relative electrical energy required for the different speed curves. In doing this I have taken the characteristic curves of railway motors of about the size required to produce the acceleration without undue heating, and calculated the current which they would take to accelerate and overcome train friction when geared for the various maximum speeds called for by the speed curves. The train friction in each case was the same as that assumed in calculating the acceleration. No allowance was made for the loss in the gears, which is a somewhat uncertain factor for various loads. This will account for the very low figures which appear later on watt hours per run, and this fact should be borne in mind for the rest of this article, as should also the fact that owing to the complication it would involve, no allowance is made for the increase in weights and alterations in efficiency of the motors as higher schedule and maximum speeds are involved. The motor weight is taken to be that

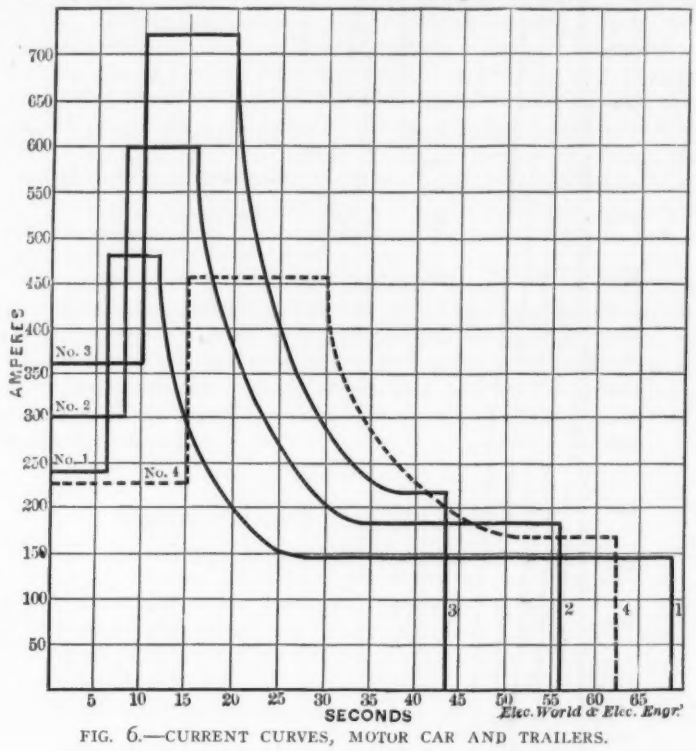


FIG. 6.—CURRENT CURVES, MOTOR CAR AND TRAILERS.

required for the lowest maximum speed in each set of curves. For each set of curves the current calculation was first made for the slowest curve in the set, and it was then assumed that for each succeeding faster curve in that set the size of the motor was so increased that the relative efficiency remained the same, or, in other words, that the current required both for acceleration and friction increased in proportion to the maximum speed of the motor.

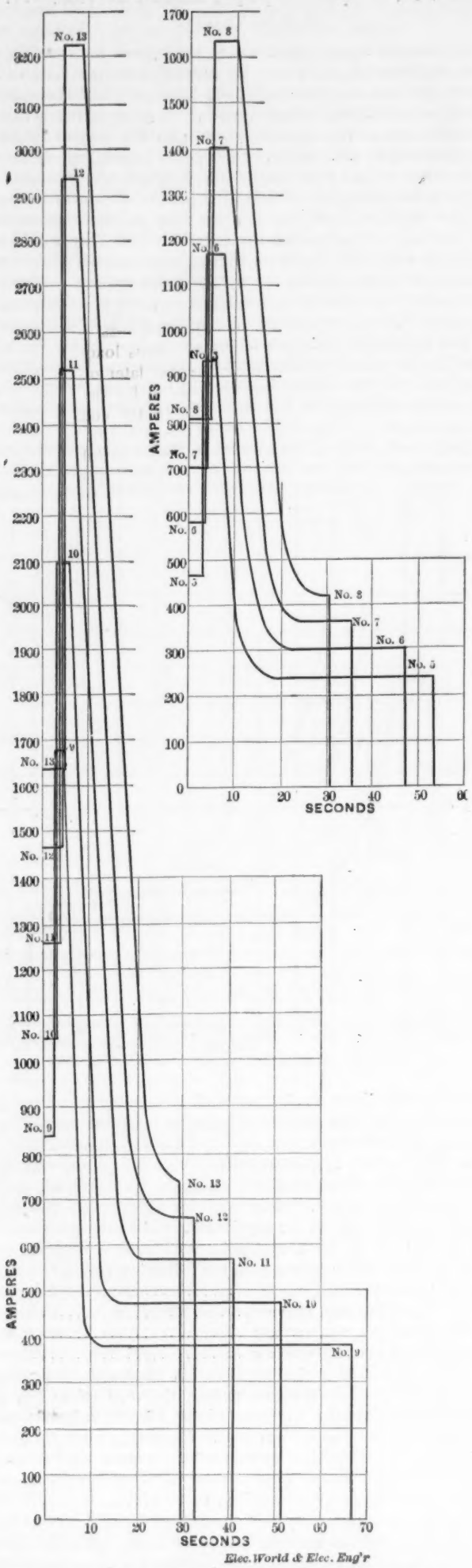
The current curves for 1, 2, 3 and 4 are shown in Fig. 6. Calculated in watt hours the curves give the following results:

Watt hours per run, curve 1.....1975
Watt hours per run, curve 2.....2270
Watt hours per run, curve 3.....2472
Watt hours per run, curve 4.....2354

As the energy used during acceleration must also be considered (since, as explained in the first article, the time tables should be arranged so that the greater part of the day the schedule can be maintained by shutting off current and coasting after the train is up to speed), it is also of value to note the energy used during the acceleration period for the various runs, which is as follows:

Watt hours during acceleration, curve 1.....1141
Watt hours during acceleration, curve 2.....1717
Watt hours during acceleration, curve 3.....2300
Watt hours during acceleration, curve 4.....2070

One of the most striking things about these results is the poor



FIGS. 7 AND 8.—CURRENT CURVES, MULTIPLE UNIT TRAIN.

economy of curve 4, which, while making a slower schedule than curve 1, still requires more energy both during the acceleration period and for the total run. Furthermore, the maximum current required by curve 4 is almost as great as that in curve 1, and is of longer duration, so that both from the standpoint of maximum demand on power house and feeders, and from the standpoint of watt hour economy the more rapid acceleration and braking shown in curve 1 is most desirable. As curve 4 comes much nearer the actual practice of the present day than the others, it would seem that there is considerable room for improvement.

Fig. 7 shows the current curves calculated for speed curves 5, 6, 7 and 8 in 4-car trains, in which half the axles are motor driven. The effect of the more rapid acceleration over curves 1, 2 and 3 is made apparent by the high maximum currents of short duration. The watt hours per run are as follows:

Watt hours per run, curve 5.....2329
Watt hours per run, curve 6.....3006
Watt hours per run, curve 7.....3239
Watt hours per run, curve 8.....3809

The watt hours during the accelerating period are as follows:

Watt hours during acceleration, curve 5.....1195
Watt hours during acceleration, curve 6.....1964
Watt hours during acceleration, curve 7.....2659
Watt hours during acceleration, curve 8.....3657

The current curves for speed curves 9, 10, 11, 12 and 13 in 4-car trains are shown in Fig. 8, the energy being as follows:

Watt hours per run, curve 9.....4284
Watt hours per run, curve 10.....4911
Watt hours per run, curve 11.....5579
Watt hours per run, curve 12.....6383
Watt hours per run, curve 13.....7315

The acceleration period energy is:

Watt hours during acceleration, curve 9.....1449
Watt hours during acceleration, curve 10.....2614
Watt hours during acceleration, curve 11.....4033
Watt hours during acceleration, curve 12.....5795
Watt hours during acceleration, curve 13.....7315

One of the first things to be noticed about the figures and curves on energy consumption per run is the large amount of energy taken to keep the train in motion after it is up to speed where there is a considerable run at maximum speed, as in curves 1, 5 and 9. This is most noticeable in the case of the multiple unit train with four motors per car and is the least with the single motor car train. The reason for this is apparent when the fact is considered that in the multiple unit trains the motor capacity is larger in proportion to the weight of the train than with the single motor car because of the more rapid acceleration that must be provided for. This makes the multiple unit motors work more underloaded than those on the single motor car when overcoming the train friction only, and hence their efficiency on such a light load is lower than the single motor car. The importance of using the coasting method as much as possible is greater with the multiple unit system than with the single motor car, and as will be seen by the figures the comparative efficiency of the three different kinds of equipment discussed here will depend very much on the way the trains are operated by the motormen, for schedules that are within the range of all three types of equipment. By manipulating the controllers and time tables right the results can be made to show most favorably to either system. With the Sprague multiple unit system as it exists to-day, the rate of turning on current at the controller is automatically regulated by the throttles and pilot motors so that a predetermined current is kept flowing through the motors during acceleration and the rate of turning on is not dependent on the ideas of the motorman. This plan of taking the rate of turning on the current out of the motorman's hands and fixing it automatically at a rate determined by calculation and test to be the proper one is certainly very desirable and some simple way of attaining this practical result would be a good thing on all electric motor cars, whether on a multiple unit system or not, as it would prevent the slipping of wheels and other wastes which are so common, as well as a wasteful slowness in turning on current, which is not so common. Even the best of motormen cannot produce results equal to an automatic device, provided the automatic device works right. Stated briefly, in the cases under consideration the maximum possible economy of energy in producing a given schedule within the reach of all the equipments lies in favor of the multiple unit system. The maximum possible economy of the motor car locomotive system is

less than the multiple unit, but if the multiple-unit system is not rightly used it may show an economy much lower than the lowest possible with the locomotive under conditions that may occur in practice. The possibiliities both in great economy and greatest lack of economy are with the multiple unit. Of course, the locomotive motive car is exceedingly limited as to schedule and length of train as compared with the

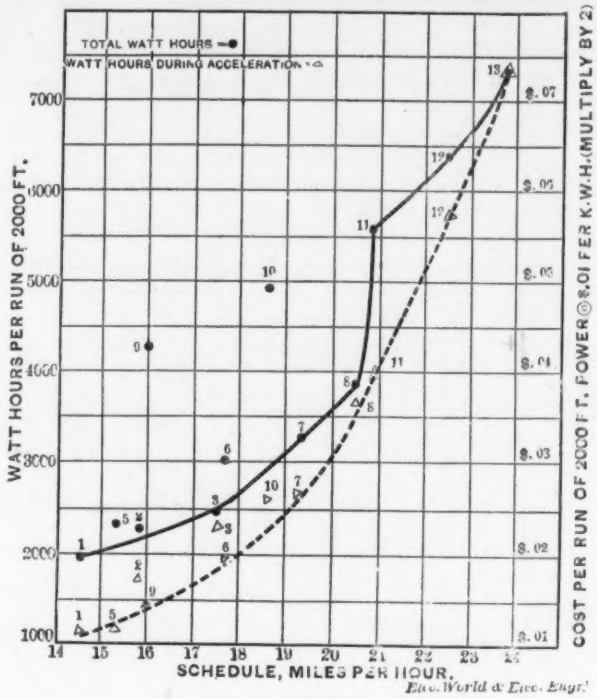

TOTAL WATT HOURS
WATT HOURS DURING ACCELERATION
WATT HOURS PER RUN OF 2000 FT.
COST PER RUN OF 2000 FT., POWER @ $.01 PER K.W.H. (MULTIPLY BY 2)
SCHEDULE, MILES PER HOUR.
Elec. World & Elec. Engr.

FIG. 9.—SPEED ENERGY CURVES.

multiple unit system, but the cost of maintenance is in favor of the locomotive where it can be used.

In order to see more easily the relations of cost and energy for the different schedules the watt hours per run and for acceleration are plotted graphically in Fig. 9, the total watt hours being indicated by dots and the watt hours during acceleration by triangles, each being numbered to correspond to its foregoing speed curve. This shows the relations of the various curves to speed and energy at a glance. If we draw a curve of maximum economy, considered from the standpoint of total watt hours per run or rush trip load, as shown by the solid line curve, Fig. 9, it takes in first 1, 2 and 3, which are for the locomotive motor car trains, then cuts 7 and 8, which are trains with half the axles driven, and finally being able to get no higher with that equipment makes an abrupt rise to the

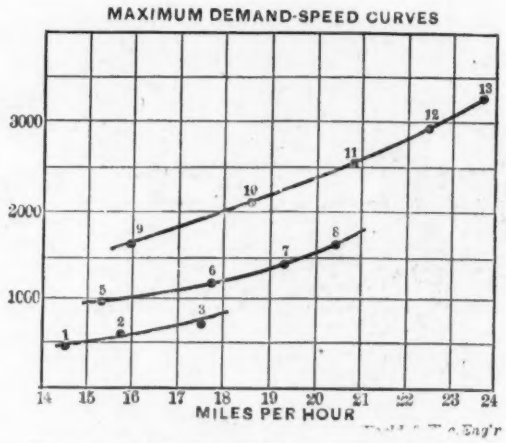


FIG. 10.—MAXIMUM DEMAND SPEED CURVES.

trains with all axles driven, 11, 12 and 13. Turning now to the curve of maximum economy, considering watt hours used during acceleration alone, we find it (as shown by the broken line, Fig. 9) beginning with 5, 6 and 7 with 1, 9 and 10 very near, and ending as all necessarily must with 11, 12 and 13. It must be remembered that this acceleration energy curve does not correspond to the actual schedule as does the other, and hence is not correct, except in the case of 13. In order to be correct for a method of operation consisting of acceleration and coasting, it would have to be moved to the left, or what is the same thing, raised at all points, except at its highest point. The energy per run is read from Fig. 9, either in terms of watt hours per run of 2000 feet or cents per run, with power at the fair average price of $.01 per kilowatt hour, $.006 being for operating expenses and $.004 for fixed charges at the power house. Owing to the lowness of the calculated figures on watt hours per run, due to a necessary omission of some uncertain losses, as explained before, and because of line losses, etc., it is safe —and will be nearly in accord with actual practice—to double the cost figures as read at the right in Fig. 9, and allowance must also be made for the fact that the actual schedule time must be lower by at least 1 to ½ miles per hour than the calculated schedules which are for the maximum possible. Allowance must also be made, as explained before, for the increasing weight of motors as the schedule increases. The object of these calculations is not so much to arrive at the exact cost of any particular schedule as to get the relative costs plainly before the mind. From the curves, Fig. 9, it can be seen how much additional passenger travel per station would have to be attracted to pay for an increase in schedule speed, power alone considered. For example, an increase from 15 to 20 miles per hour would call for earnings of 3 to 4 cents more per station to pay for the increased power. The saving in trainmen's wages per run by such an increase of speed with one motorman at 25 cents per hour and three guards at 15 cents per hour would be ½ cent. The cost of motor repairs, interest on cost of feeders, etc., cannot be figured on here because of the influence of local conditions, but, of course, they would increase greatly, with increase in schedule. Fig. 10 shows curves of maximum current demand, with various equipments, and helps throw some light on the amount of generating machinery and feeders necessary, though, of course, the maximum current demand on the power house and storage batteries (if there are any) depends on many other factors than the maximum demand of each train. The number of trains in service is one of these factors.

The calculations in this article do not pretend to go more than part way into the subject of the cost of increasing schedule speeds. They cover only one set of conditions and do not consider all of the minor factors, but it is believed that they may add some to the fund of common information on a subject that little is known of outside of the offices of a few engineers who have given the matter special attention.

Electricity in the Italian Navy—IV.

By Giulio Martinez.

EXPERIMENTS are now being conducted to develop for use with each individual motor a circuit breaker to act as an ordinary main switch, and which will open the circuit at overloads, or at cessation of the current. Motors that operate without attendance, must be protected against the bad effects which might result from a

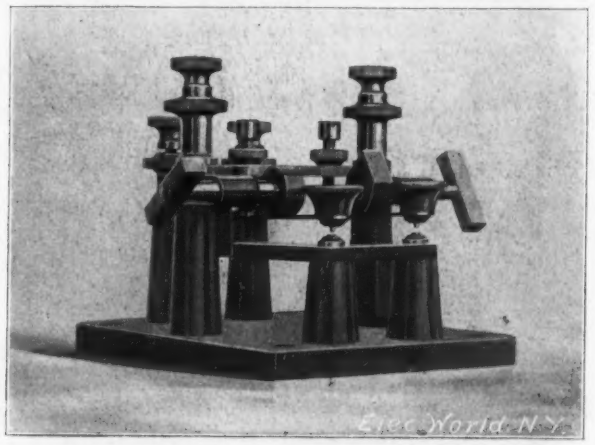


FIG. 24.—REVERSING KEY.

short temporary cessation of the current followed by its renewal. M. Civita, an electrician of the Navy, seems to have solved the problem with a mechanism which performs all the necessary operations and is both simple and cheap to build.

Electric motors have been connected to the machine tools used

in the small machine shops which every modern vessel is equipped with. Fig. 25 is a cut of a lathe driven by a Brioschi & Finzi

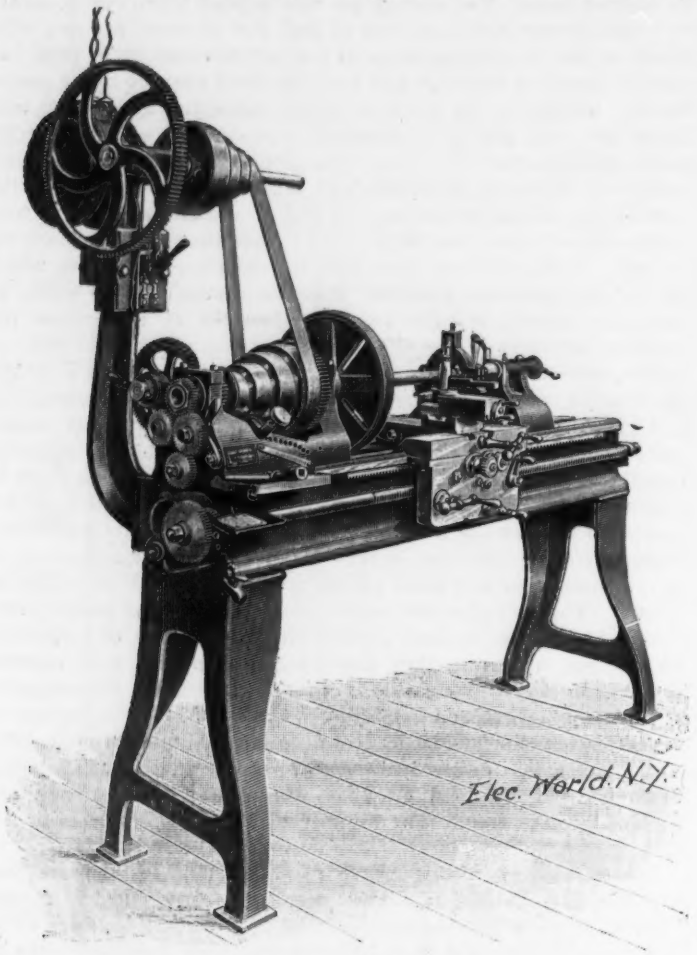


FIG. 25.—BRIOSCHI & FINZI LATHE.

motor. Small fan motors of 1-16-hp to ⅛-hp are also universally used in the staterooms and officers' quarters.

Perhaps one of the most important uses made of electricity is the aiming of the large guns.

Lengthy experiments were carried out on the cruiser Fieramosca,

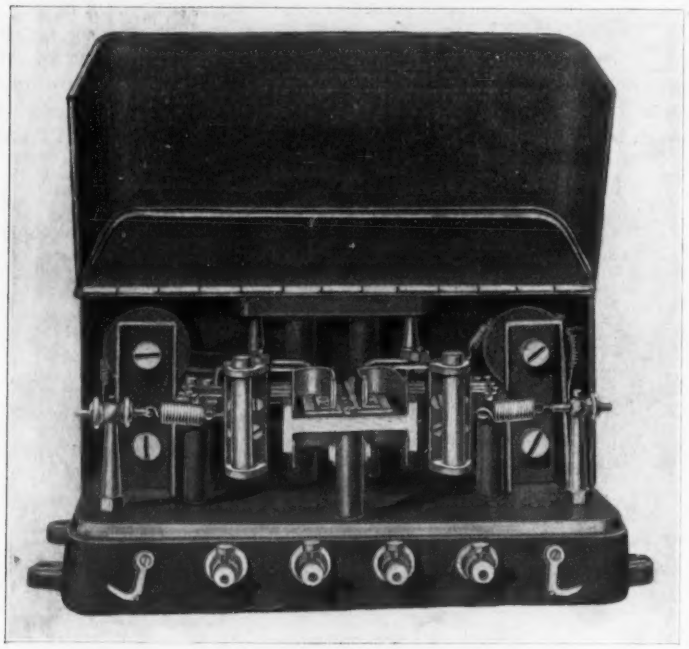


FIG. 27.—PASQUALINI CONTROLLER.

4500 tons, which carries two 10-inch, 25-ton Armstrong guns which are arranged to be moved by hydraulic and hand power.

The first plant, put in three or four years ago, was fitted with a two-pole, slow speed series motor of 14 brake horse-power, built at Oerliken, and started by an ordinary rheostat fo rcutting out resistance slowly. This plant was chiefly useful in furnishing accurate data on the power that was required to do the work, and the range in speed which might be secured. It was found that the motor took about twice as much current on starting as it did when running normally, and that the current consumption was practically independent of the speed. This resulted in a sudden starting, and it was often necessary to introduce into the circuit for running at slow speeds resistance which had been previously cut out on starting. This complicated the operation of aiming, requiring great attention and considerable expertness on the part of the man handling the apparatus.

On the other hand, it was found that neither generator nor motor suffered in the least from starting suddenly with almost no resistance in circuit, due, probably, to the effect of the self-induction of the motor in keeping the current from rising too rapidly, and under these circumstances the start became practically instantaneous.

It was about this time that the Boret magnetic clutch was tried,

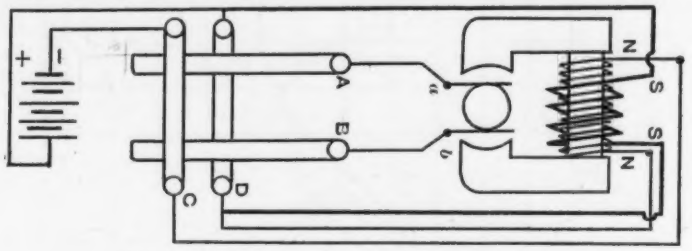


FIG. 26.—DIAGRAM OF CONTROLLER CIRCUIT.

and it suggested to the author the idea of using two motors for one turret: A powerful motor for quick movement and one of less power and a large speed reduction for the more delicate adjustment of the aim.

The small motor acted on the shaft of the larger through a worm and gear, the gear being connected with the shaft by a Boret magnetic clutch in series with the armature of the small motor, which made the coupling of the latter to the work automatic. This idea was developed by M. Pasqualini, who applied it on the cruiser Garibaldi intended for the Italian Government, but which was sold by the builders to the Argentine Republic.

In the installation for the Garibaldi which was duplicated with some few changes on board the sister ships, Cristobal Colon, Gen. San Martin, Gen. Belgrano, and Pueyrredon, a special controller was used to switch the current from one motor to the other, introducing at first some resistance into the circuit and afterwards cutting it out. This controller bore some resemblance to a railway controller, but it was inconvenient. It required too much attention

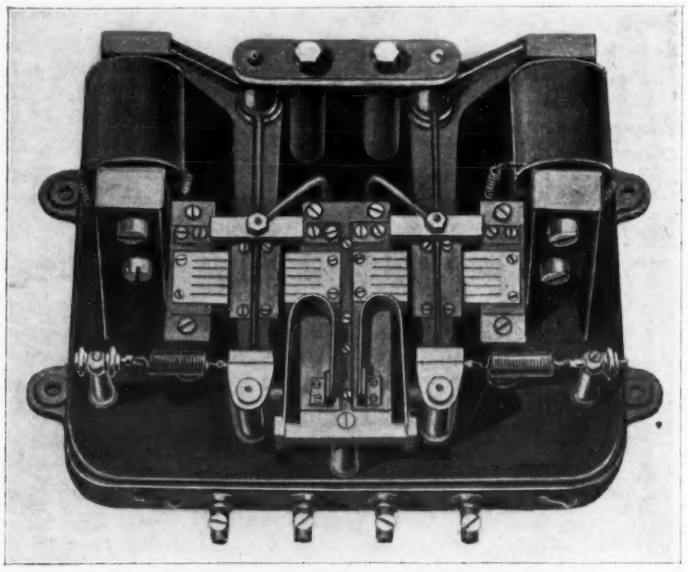


FIG. 27A.—PASQUALINI CONTROLLER.

from the gunner, who ought to be able to control the movement of his gun mechanically and without any special mental application.

It was found also that it was necessary to regulate the speed of the mtors. M. Pasqualini then tried his electromagnetic con-

troller, which gave extremely good results, and was adopted by the navy for the Garibaldi, the Varese, the Amiraglio di St. Bon, the Filiberto and the Dandolo. The last named of these vessels was built in 1878 and her 18-inch, 100-ton turret guns have been replaced

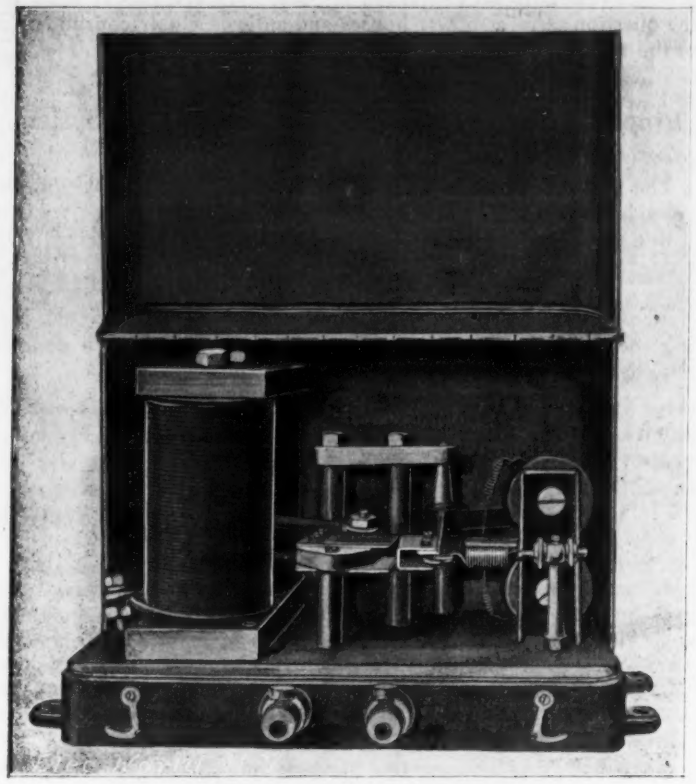


FIG. 28.—AUTOMATIC RHEOSTAT.

There is no starting rheostat used in connection with the small motor; the large one is provided with an automatic rheostat consisting of a coil of copper wire wound on a closed magnetic circuit, and having a resistance of 0.6 to 0.8 ohm. This resistance is short circuited at the proper time by an electro magnet connected across the brushes of the motor, set to act when the counter e. m. f. has reached a sufficiently high value. With the small motor it was found to be sufficient to make the series winding of a slightly higher resistance than would ordinarily be necessary.

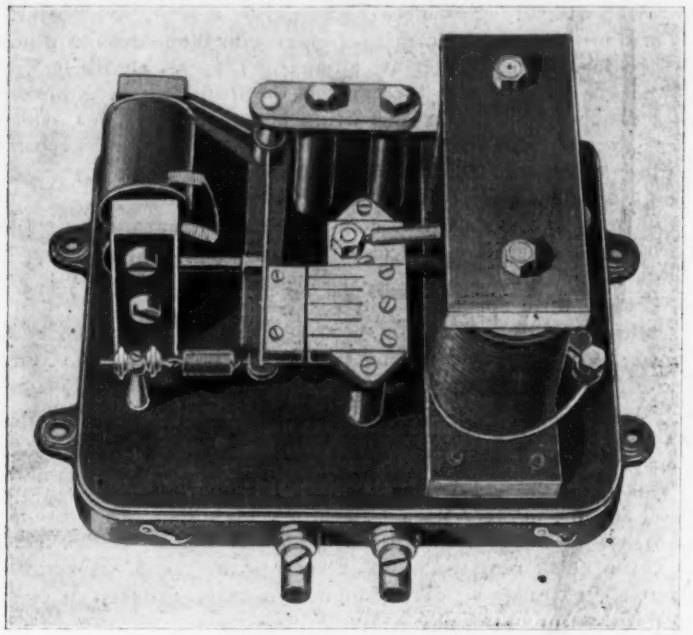


FIG. 28A.—AUTOMATIC RHEOSTAT.

by 10-inch, 25-ton guns, mounted in barbette. The two first ships mentioned have two turrets with a single gun in each; the others all have two turrets with two guns, all 10-inch.

The same apparatus was used throughout. The larger motor has a capacity of 16 to 18-hp; the smaller 5 to 6. They are provided

A model of the turret of the Dandolo was exhibited at the Turin exhibition with two guns arranged to be moved by the electro magnetic controllers which will be described presently, and which were mounted with the working parts exposed so that the method of operation could be followed as in a diagram.

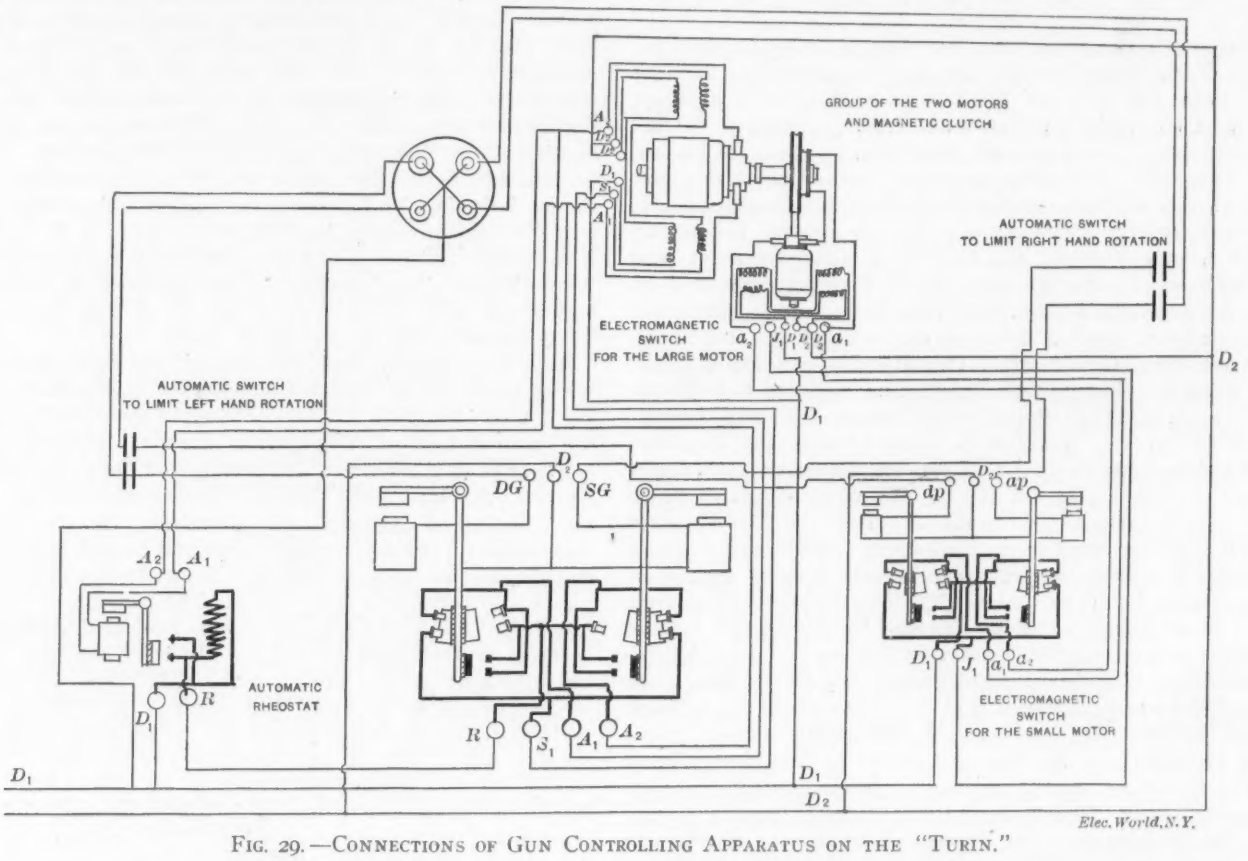


FIG. 29.—CONNECTIONS OF GUN CONTROLLING APPARATUS ON THE "TURIN."

with powerful series windings and small shunt winding just large enough to overcome the armature reaction. The controller is nothing more than a reversing key, like that shown in Fig. 24. Suppose a compound wound motor and a reversing switch able to handle heavy circuit.

currents, arranged as in the diagram of Fig. 26. On depressing one of the keys, the motor will start in one direction or the other; on depressing both keys or allowing the depressed key to return, the armature is short circuited, and being in a field it will stop sharply. The start will be equally sharp, but if the key be depressed only for an instant the motor can make but a very few revolutions, perhaps, even, only a fraction of a revolution.

Pasqualini's controller is nothing more nor less than a reversing switch built to carry and to break large currents without injury, but they are operated by electro magnets which the gunner manipulates with ordinary small push buttons.

The dimensions of the controllers vary with the motors to which they belong, otherwise they are all alike. They are shown in Fig. 27 and 27a. To preserve the contacts the main current is broken on a double break, the arc occurring between carbon tips, which keeps the contacts proper in good condition. This arrangement has been much used in other places as well.

Figs. 28 and 28a are cuts of the automatic rheostat.

Fig. 29 is a diagram of the connections of the apparatus used at Turin, being taken directly from an operating installation. Fig. 20 shows the method of using the clothes pin pressure switches for the control of the apparatus.

Under normal conditions, a speed of 7 degrees per second is attained, and the slowest motion possible is ½ degree per second. By working the pressure switches by short jerks, extremely small movements are obtainable and the adjustment of the aim is very perfect and requires no special skill on the gunner's part. One very soon learns to control the gun.

This arrangement has very great advantages, both from the electrical and the military sides. The whole main part of the connections lies with the motors in the protected portion of the vessel, not even being near the movable parts of the turret. A five-wire flexible cord, easily replaced if injured, connects the interior of the turret with the apparatus.

An advantage resulting from the use of the small motor is that it is possible to operate the turret machinery from the ordinary circuits, when it is desired to make sure that everything is in working order.

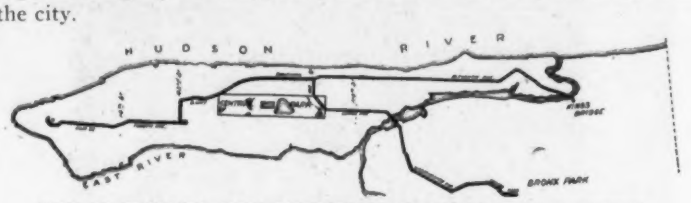
Agreement Between the Manhattan Elevated and Third Avenue Railways.

A further step in the provision of better rapid transit facilities for New York City is found in an agreement just entered into between the Manhattan Elevated and Third Avenue Railway Companies. This official statement for the Manhattan Railway Company, dictated by President Gould, was issued by Charles A. Gardiner, of Davies, Stone & Auerbach: "A traffic agreement, to take effect not later than May 1, 1899, has been entered into between the Manhattan Elevated System and the Third Avenue Railway System, comprising the Third Avenue Railroad, the Dry Dock, East Broadway, and Battery Railroad, the Forty-second Street, Manhattanville and St. Nicholas Avenue Railroad, and the Union Railway lines, which will furnish cross-town transfers to the elevated railways at Canal Street, Grand Street, Forty-second Street, One Hundred and Tenth Street, One Hundred and Twenty-fifth Street, One Hundred and Thirty-fifth Street, and at all the streets in the Twenty-third and Twenty-fourth Wards where connection is made between the Suburban Elevated and the lines of the Union Railway Company, for a transfer of 3 cents. Passengers will also be able to transfer at all Third Avenue elevated stations between the City Hall and One Hundred and Seventy-seventh Street to the surface cars beneath, and continue their journey to intermediate streets, practically making each street corner an elevated railway station. The new scheme will connect the upper Tenth Avenue cable line and also the Amsterdam Avenue and Boulevard lines with the lower west side by means of the elevated railroads at One Hundred and Twenty-fifth Street, Sixty-sixth Street, and Forty-second Street. The west side, served by the Sixth and Ninth Avenue trains, it is expected, will produce a large volume of travel, particularly on Sundays, for transfer to One Hundred and Thirty-fifth Street and Eighth Avenue to the Union Railway Company's trolley lines, running across the Madison Avenue Bridge through the park system of the borough of the Bronx, and between Yonkers on the Hudson River and New Rochelle on the Sound, for 8 cents. It is expressly provided that the 8-cent fare shall apply to express as well as local trains."

President Gould said on the subject: "This is one of the changes we intend to work out by degrees in connection with the change of motive power and the enlargement and improvement of the elevated roads. A strong point in the plan is that it takes effect and will produce results to all concerned at once. We are also at work on the question of joint power houses and an even closer consolidation of the two systems."

Proposed Metropolitan Underground Electric System.

The proposition made by the Metropolitan Street Railway Company, last week, as noted in these columns, to furnish New York City with a complete underground electric system, has been received with almost unanimous approval. Objections have been made chiefly on three scores, namely, the 10-cent express fare, the perpetuity of the franchise, and the subway wire rights furnished by the tunnel, giving the company a strong hold on all the electrical work done in the city.



MAP OF PROPOSED NEW METROPOLITAN UNDERGROUND SYSTEM.

A member of the Rapid Transit Commission is quoted as saying: "Through this tunnel or subway the Metropolitan Company could operate pneumatic tubes a distance of 11 miles through the heart of the city. They could convey heat, light, and power, hot and cold air, telegraph and telephone wires, besides gas and water pipes, all of which would yield a large revenue."

President Vreeland, of the Metropolitan Street Railway Company, commented on this phase of the subject as follows: "With regard to the right we demand to rent space in the subway galleries without compensating the city with any part of the rentals I can only say that it is an absolutely essential feature of our offer and one that could not and will not be modified."

The physical system proposed is shown fairly in the outline map herewith. The lower part of the city up to the City Hall, with loops, is laid out for two tracks; there are then four tracks up Fourth Avenue to Forty-second Street and across to the Boulevard west of Central Park. At One Hundred and Fourth Street two elevated tracks run up Eleventh Avenue across the valley becoming tunnel again in the hill which attains its greatest altitude around One Hundred and Eighty-first Street, where it soon becomes an elevated section again running across Spuyten Duyvil Creek to Kingsbridge. At the upper end of Central Park there will be in time another section, as shown, following the Lenox Avenue underrunning trolley route out into Westchester county, but that section is not to be built until the Kingsbridge division pays 5 per cent. on the cost of construction. Below Ninety-sixth Street trains are scheduled as expresses at as high a rate as 20 miles an hour, and for at least two miles below Forty-second Street at 30 miles an hour.

Another proposal to build the underground railroad has been submitted to the Rapid Transit Commission. It was sent on Monday, April 3, to Alexander E. Orr, president of the commission, through the hands of Lewis L. Delafield, its secretary, by Frederic B. Esler, a lawyer of 40 Wall Street, and president of the corporation making the offer, the Metropolis Contract Company, which Mr. Esler says has a capital of $5,000,000, all subscribed. He also says that its stockholders include some of the strongest financiers of the city, but that they are unwilling to have their names known as long as the acceptance of their offer is uncertain. The proposal is such that the board does not need additional powers conferred by the legislature in order to treat with its makers. In brief, the offer is made to build the road for the city for nothing, in return for the privilege of operating it for 50 years, and reaping the profits on the route for that period, less 5 per cent. of the annual gross receipts from all sources, which will be paid into the city treasury. The city is to advance the company $33,000,000, to be obtained by an issue of bonds, to defray the expenses of building the road, which is to be constructed in two years and a half. The company agrees to pay the interest on these bonds and create a sinking fund, which will ultimately redeem the bonds. At the end of 50 years after the road has been built the city is to receive it, free and clear of incumbrances.

CURRENT NEWS AND NOTES.

A DISTRICT MESSENGER BOY has now left London for California, the object being to outdo the speed of the boy who lately made the trip to Chicago. This is becoming tiresome. The third boy will be killed on arrival.

THE FUTURE OF ELECTRICAL ENGINEERING.—A writer in a London contemporary, referring to some recent experiments by the physicist Broca concerning vacuum tubes, remarks that it may safely be said "that the future of electrical engineering is sealed up in the vacuum tube."

OPERATION OF RAILWAYS SUSPENDED.—The two electric street railway systems of Austin, Texas, ceased operation temporarily on account of lack of water power to run the electric plant. Preparations are being made to put in an auxiliary steam plant. No street cars were run for several days.

CONVENTION POSTPONED ON ACCOUNT OF SMALLPOX.—Owing to the prevalence of smallpox at Laredo and other points in Texas the annual convention of the Southwestern Gas, Electric and Street Railway Association, which was to have been held in Austin, Tex., April 19, 20 and 21, has been postponed one month.

THE USE OF PATENTS.—The Indiana Appellate Court recently held that an employee who experiments with his patented inventions by using them in carrying on his employer's business, without any contract for payment for their use cannot enforce payment for the use of such as prove valuable after he has been discharged.

MEXICAN WATER POWER CONCESSION.—An application has been made to the Mexican Government by Pedro Amieva, a Mexican capitalist, for a concession to use the waters of the Matamoros river in the state of Puebla for the generation of power. He proposes to install a large electric power plant for running a number of small manufacturing industries in that section. The plant will be located at the town of Izucar de Matamoros, state of Puebla.

NEW POWER STATION.—The Yuba Electric Power Company, of Marysville, Cal., is constructing an additional electric power station with a capacity of about 5000-hp. There will be about eight miles of flume, and the new plant will be located about eight miles from the one now in operation. One thousand kilowatt generating units will be used, each consisting of a water wheel and a Stanley two-phase generator. The firm of Hunt, Benjamin & Meredith, San Francisco, is engaged in the engineering work for the new installation. At least 10,000-hp can be developed, in time, at the new site.

INDIANIANS MAY VOTE ON FRANCHISES.—One of the new laws for Indiana provides that no ordinance for the purchase or establishment of any waterworks or lighting plant or granting a franchise for any company to operate any waterworks, lighting plant, street railroad, telephone or telegraph company in an incorporated town shall go into effect until 30 days after its adoption. If 40 per cent. of the voters in the town ask to have the ordinance submitted to a vote of the electors of the town it shall be so submitted, and if rejected by a majority of the votes cast it shall not take effect, and no similar ordinance can be adopted for three years afterward.

SUBSTITUTING ELECTRIC TRACTION FOR STEAM.—The Brooklyn Rapid Transit Company has commenced the work of equipping the Brooklyn and Brighton Beach Railroad with electric power. There are 65,000 feet of railroad bed to be taken up, and it is expected to convert 2000 feet each day, so that the road with its new power may be in operation about May 1. The cars will be of the long double-truck pattern similar to those in use on the Heights road. It is announced that negotiations are under way for the acquisition of the Manhattan Beach property by the Rapid Transit Company. The Rapid Transit Company acquired control of the Brighton Beach road recently.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.—The convention committee of the Board of Trade, at Wilmington, Del., to attend to plans for the next meeting of the National Association of Municipal Electricians, met last week at the Clayton House. A. S. Reed, chairman of the reception committee, announced that he had appointed Colonel Enoch Moore, A. C. McCausland, Josiah Marvel and Alvin R. Morrison to serve on the committee. John C. Farra was elected chairman of the finance committee. The Wilmington City Electric Company has engaged space for an exhibit of electrical apparatus for cooking and other purposes. The committee adjourned to meet on April 6, when it is expected that the finance committee will make a report.

TRIED TO KILL LOUBET.—A special despatch from Paris of April 1 says: A wealthy man named Tourret was shot dead last evening on the Bois de Boulogne by a man who mistook his victim for President Loubet, to whom M. Tourret bore a striking resemblance. The murderer, whose name is Osouf and who is thirty-eight years old, is thought to be insane. He is an electrical engineer who lost his fortune in the Panama smash. It is suggested that the mention of the Panama scandals in connection with M. Loubet's election is responsible for the man's desire to assassinate the President. The assassin fired two bullets into M. Tourret, who expired immediately afterward.

LONG DISTANCE FIRES.—A falling tree in Danbury, Conn., a few days ago was the indirect cause of two fires several miles away and the temporary suspension of traffic on the Danbury & Bethel Electric Railroad. The tree, in falling, carried down some wires of the Postal Telegraph Company crossing them with the trolley wire. The heavy current from the latter found its way to Pound Ridge, 20 miles from Danbury, and set fire to the telegraph switchboard, and then it continued swiftly on its errand of destruction. It landed in New York and set fire to the switchboard of a suburban telegraph office. In both cases the fires were quickly extinguished. Fires were also started in the Postal Company's office on State Street, Boston, and in the Hartford office of the same company. Business on the electric railway was suspended an hour.

IMPORTANT CHANGES ON THE BROOKLYN ELEVATED LINES.—It is announced that the Brooklyn Rapid Transit Company will run open cars on the Brooklyn Union Elevated Railroad during the warm weather. It is also stated the the Rapid Transit Company and the Long Island Railroad Company have agreed to a traffic contract by which the latter company will be able to carry its passengers to the bridge over the elevated structure. Work has already commenced in substituting electric power on the elevated road. The three-rail electric system, such as is in use on the bridge, will be put up on all the lines. It is expected to have work on the Fifth avenue line completed in six weeks. Elevators to carry passengers from the street to the platforms are to be erected at the principal stations. It is estimated that the improvements contemplated will cost between $2,000,000 and $3,000,000. It is said that the new management will introduce some important changes in the operations of both the surface and elevated cars over the bridge. Elevated cars running through to Manhattan may be discontinued, and there is to be a considerable decrease in the number of trolley cars operated on the bridge. The surface lines are to be used chiefly for the accommodation of short-distance riders, while persons living in the suburbs will be encouraged to use the elevated trains.

OUTPUT OF TELEPHONES.—The Bell Telephone instrument statement for the month ended March 20 shows:

	1899.	1898.	1897.	1896.
Gross output	67,033	28,909	19,192	19,283
Returned	13,530	15,737	6,495	7,331
Net output	53,503	13,172	12,697	11,952
Since Dec. 20:				
Gross output	162,844	80,667	53,309	54,993
Returned	41,725	38,568	20,911	22,132
Net output	121,119	42,099	32,398	32,861
Total outstanding	1,246,365	961,220	806,247	709,397

Notwithstanding the fact that the Bell Co.'s instrument manufacturing department is increasing the size of its plant and has a larger working force than ever before, the company was unable to fill its March orders for instruments by 10,000. Had the company installed instruments for all orders received, the gross and net output for March would have been 77,000 and 63,000, respectively.

NO SALE OF CHICAGO EDISON COMPANY.—It was reported in one of the electrical papers last week, with a great air of circumstantiality that the Chicago Gas Company was buying up the Chicago Edison Company, the Commonwealth Company, etc., the report being merely the expansion of a bull rumor circulated in Wall Street in connection with the advancing price of the gas stock. We are in receipt of a telegram from President Insull, of the Chicago Edison Company, in which he says: "You can state in your next issue on my authority that there is no truth in the statement with reference to negotiations being under way for the sale of the Chicago Edison Company to the Chicago Gas Company or any other company."

TO PHILADELPHIA BY TROLLEY.—The papers providing for the leasing of the North Hudson County Railway Company's lines to the North Jersey Street Railway Company are being prepared. This amalgamation, which has been expected for several months, will be one more step towards the formation of a continuous trolley line across New Jersey from the Hudson River to Philadelphia. Over connecting trolley roads it will soon be possible to ride from Jersey City west as far as New Brunswick, in Middlesex county. In the meantime the trolley roads east of Philadelphia, in New Jersey, are being developed and extended westward to meet the roads from the East. Soon the remaining connecting links necessary to complete the cross-state line, will be provided by the construction of a line from Camden to Bordentown and Trenton, from Trenton to Princeton, and from Princeton to New Brunswick.

THE WESTINGHOUSE-GENERAL ELECTRIC LITIGATION.—A special despatch to the Boston *Herald* of March 30 from Boston, gives the following version of the status of the dispute over the right to sell multiphase apparatus in New York City: "When asked if the suit brought by the Westinghouse Electric and Manufacturing Company against the General Electric Company, in the United States Court of Utica, N. Y., was a friendly one of minor importance, as stated in the East, Mr. Westinghouse replied that the suit was relative to certain clauses of the patent agreement between the two companies providing for the maintenance of the patent rights of the few licensees of the Westinghouse Company, and the numerous ones of the General Electric Company. After protracted discussion, the General Electric Company finally recognized by an agreement in 1896 the rights of the Westinghouse Company in their Brooklyn Edison territory. The actions of the officials of the General Electric Company in contracting to deliver further apparatus in New York in violation of the terms of the agreement left no alternative except to institute the above mentioned suit, which, under the instructions of the directors of the Westinghouse Company, will be vigorously pushed. The suit is, therefore, a determined effort on the part of the Westinghouse Company to secure a decision which will be favorable to the rights of the licensees of both companies. The agreement exchanging licenses as a whole will not necessarily be jeopardized by the present suit, though the relations between the two companies are, and have been for over two years, very strained. Future smooth working and satisfactory results under the patent agreement rest entirely with the directors of the General Electric Company." The case has not yet come up for hearing nor has the General Electric answer been filed.

WIRELESS TELEGRAPHY.—Signor Marconi has expressed an intention to visit the United States in October in order to show the American people the practical results to be obtained in wireless telegraphy. He considers that communication between England and America by the wireless telegraph is no dream, but among the scientific possibilities of the near future. One difficulty that at present interposes is the height of the poles it would be necessary to erect on either side of the Atlantic. At present it would appear that these poles would have to be from 1100 to 1500 feet high. Improvements in the apparatus, however, may remove this requirement, and he states that when he first operated over a distance of only eight miles it was necessary to erect poles over 140 feet high, while at present an elevation of but 40 feet is necessary for that distance. The extreme cheapness of wireless telegraphy he believes to be one of its strong recommendations. As an example, in his recent English Channel experiment when signals were transmitted a distance of 32 miles, the instalment did not cost more than $1,500. Prof. J. A. Fleming informed a newspaper correspondent that there is no doubt but that the wireless system is a success, and he does not consider that communication can necessarily be destroyed by introducing an induction coil between the terminals. In this connection the fact was instanced that a large induction coil in the South Foreland lighthouse, near Marconi's instrument had not the slightest effect on messages. The present rate of speed of Marconi's system is only 15 words a minute, which fact has been urged against its practicability in competition with the ordinary telegraph, by which a speed of 600 words a minute has been attained. Lord Kelvin was interviewed on the subject and said he is not at all surprised by the results attained by Marconi, and believes that wireless telegraphy has already become a practical success and that its future is immense. Prof. Silvanus P. Thompson stated that he believes it will be possible to establisn direct communication by this means across space, either between England and India or even to Australia, far cheaper than by the submarine cable. Nine years ago he offered to establish telegraphic communication with the Cape of Good Hope, provided $50,000 was forthcoming, and he believes that before long the proposed scheme, then ridiculed, will be realized.

LETTERS TO THE EDITOR.

Two-Phase vs. Three-Phase Systems.

To the Editors of Electrical World and Electrical Engineer:

Sirs—I have read your recent editorial on "Two-phase versus Three-phase Systems." The general statement regarding the characteristics of the two systems is correct, i. e., that the three-phase system is advantageous in transmission as it requires 25 per cent. less copper than is required for an equivalent transmission by the two-phase system, and on the other hand, that the two-phase system, is advantageous for the distribution circuits, as there are not so likely to be seriously unbalanced conditions in the pressure, caused by unequal loading of the circuits. Such expressions, however, as "the two-phase advocates" imply that there is a controversy of the sort which makes the advocates of each system enthusiastic in its favor and unaffected by the alleged advantages of the other system.

This undue adhesion to a single system is certainly not universal. In the engineering of the Westinghouse Company, for example, due consideration is given to the characteristics possessed by each system, and in each individual case the number of phases best adapted to the conditions is used. There is no Westinghouse long-distance transmission of power which does not employ three-phase transmission; on the other hand, there is no extensive distribution system (in which there is loading upon individual phases, such for example as incandescent lighting), which employs the three-phase system. In those plants in which there is both transmission and distribution for lighting, the three-phase current used in transmission is transformed into two-phase for distribution. The Westinghouse Company has sold over 56,000 kilowatts of transformers for transforming between two-phase and three-phase, in about fifty plants. In some cases current is derived from two-phase generators and is transformed in the raising transformers to three-phase current and is retransformed to two-phase current at the substation. In other cases the current from three-phase generators is transmitted to lowering transformers which produce two-phase current. There are many places, moreover, in which the three-phase current is used for distribution for power work in which three-phase motors are employed. When a small amount of lighting is required in connection with the power circuits it is sometimes taken from the three-phase circuits.

The sensible method is certainly to use the flexibility of the polyphase system for obtaining in each part of a large plant the system which is best adapted to the special requirements, employing three-phase where the three-phase current is most economical, transforming to two-phase where the characteristics of such circuits make them most desirable, or converting the current into direct current by the rotary converter, when the direct current is more advantageous than the alternating.

With respect to rotary converters, your editorial states that "the two-phase converter will give about 25 per cent. more output for given loss of power by heat in the conductors than the same machine used as a three-phase converter." This statement, although it may in itself be true, is misleading and is rendered more so by the fact that a large proportion of the space under the heading

"Two-phase versus Three-phase Systems" is occupied by a discussion of rotary converters. As a matter of fact, however, there is in general no practical difference between the two-phase and three-phase rotary converter, as a machine of given size has practically the same output whether it be connected and operated as a two-phase machine or as a three-phase machine. The heating in the armature conductors is a small portion of the total heat in the rotary converter, so that the heating in the conductors is usually not the determining element in the output. If, for example, we should attempt to increase the current when the machine is made two-phase, until the heating in the armature conductors is the same as that with the three-phase connection, the greater current would involve much increased loss at the commutator and in the brushes. The practical result is that with the same limits as to commutation, the same machine may be connected for either two-phase or three-phase, and when operated to give the same output, the difference in the total loss in the machine and in the temperature in the two cases is generally so small as to be negligible, and to give no practical advantage as to the two-phase over the three-phase machine. An exception occurs in low frequency rotary converters of large size for low voltage where the armature currents become comparatively very great. In this case the two-phase rotary is superior to the three-phase rotary.

Your editorial refers to the complex character of a machine which involves in itself the complexities of the synchronous multiphase motor and direct current generator. It is to be noted, however, that rotaries are now operated on circuits of almost every description, and that the rotary converter has demonstrated its applicability to practically every condition of service.

CHAS. F. SCOTT.

PITTSBURG, PA.

Frazil Ice in Lachine Rapids.

To the Editors of Electrical World and Engineer:

Sirs—We have read with considerable interest the article on "Frazil Ice in Lachine Rapids" in the issue of THE ELECTRICAL ENGINEER of Feb. 23, 1899. We would explain that we were jointly, with W. McLea Walbank, Esq., engineers of this development, but since August, 1897, when the water was let into the headrace, we have not been consulted in regard to the work—our associate, Mr. Walbank, who is also managing director of the company, having had sole charge of the plant.

The trouble in regard to ice shoving across tailrace will be obviated when the plant is in full operation. At present the volume of water discharged by the small proportion of plant in operation is

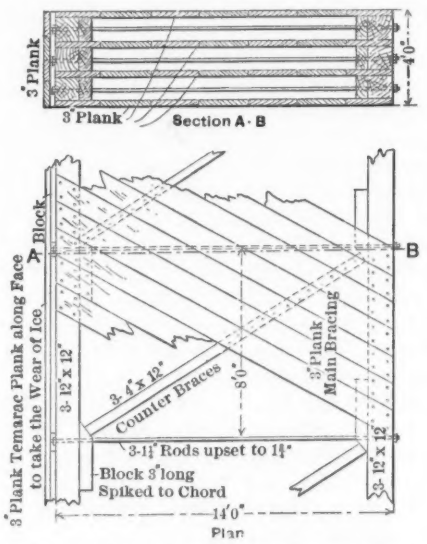


FIG. 1.—HOWE TRUSS, FORMING BOOM ACROSS ENTRANCE TO HEAD RACE.

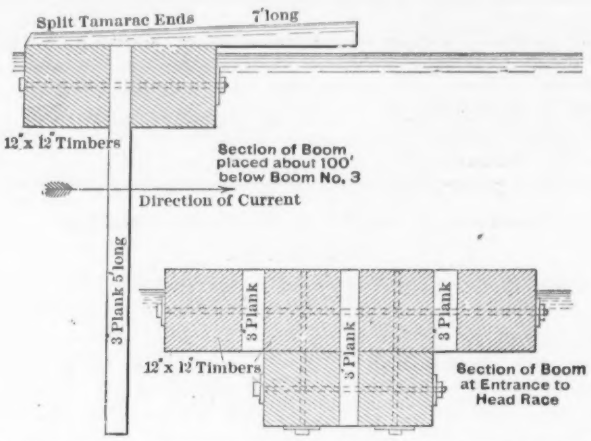
insufficient to keep the ice from the main channel shoving across the lower end of the tailrace and backing up the water. It is feasible to prevent this trouble, even under present conditions, at small cost.

In regard to trouble with frazil in headrace, among the plans made in our office was one involving piers and a deep boom across the entrance to the headrace. This boom, as shown by accompanying diagram, Fig. 1, was to have been 14 feet wide by 4 feet deep, made in the form of a Howe truss, to give requisite stiffness between piers. Although the heavy piers required were put in, this boom itself was never used, but instead the booms mentioned in the article referred to were substituted, a sketch of which is given in Figs. 2, 3 and 4.

It is hardly necessary to say that these are entirely inadequate. The boom across headrace is of such cross section that the floating anchor ice, which is of very low specific gravity, on coming into contact with it goes down under the first timber, and being then unable to rise to the surface, is almost immediately carried under the remainder of boom and into the headrace.

It is only necessary to visit the site when the ice is running, to be convinced that all that is required is to divert the ice on an easy angle with a suitable boom for about 600 feet from the shore end. Beyond this the current would take care of the ice, and in fact it would actually carry it away from the line of boom out into the rapids.

In conclusion, it has been demonstrated that the trouble with frazil cannot be overcome with the present form of booms, though they turned a considerable portion of ice out into the stream, and we are still of the opinion, repeatedly urged on the company, that


Split Tamarac Ends
7' long
12" x 12" Timbers
Section of Boom placed about 100' below Boom No. 3
Direction of Current
3" Plank 5' long
3" Plank
3" Plank
3" Plank
12" x 12" Timbers
Section of Boom at Entrance to Head Race

FIGS. 2 AND 3.—SECTIONS OF BOOM AT ENTRANCE TO HEAD RACE.

the construction of the deep boom, as designed by us, will eliminate the trouble recently experienced with anchor ice.

T. PRINGLE & SON.

MONTREAL, CAN.

Armature E. M. F. and Number of Poles.

To the Editors of Electrical World and Engineer:

Sirs—Your comment on my communication in your issue of March 25, does not, in my humble opinion, in any way answer the objection stated.

You say, "since the number of pairs of poles is always exactly half the number of poles, it is absolutely indifferent whether the e. m. f. be expressed as a function of either." I join issue with you as to this application in the instance quoted.

True, we may express the e. m. f. as a function of the number of poles, number of pairs of poles (or more properly speaking, the effective flux from such poles), magnetomotive force, magnetic flux, or ampere-turns of field excitation, but in the premises referred to in your issue of March 11, it is utterly inapplicable.

Take the fundamental equation for the total e. m. f. generated by armature, viz.:

$$E = \Phi A n 10^{-8} \qquad (1)$$

where E = total e. m. f.; Φ = effective flux through armature; A = number of armature conductors; n = number of revolutions per second, and 10^{-8} the multiplier necessary to reduce from C. G. S. to practical units.

Consider a bipolar machine, and apply the formula as deduced in your editorial of March 11, comparing it with the foregoing. There are two poles; the direction of effective flux is from north to south, the magnetic lines simply flowing in this positive direction from the face of the pole-piece, through the armature, returning through the opposite pole-piece, yoke and limbs.

Your formula as expressed, is as follows:

$$E = n p A \Phi 10^{-8} \qquad (2)$$

where E = total e. m. f.; n = number of revolutions per second;

p = number of poles = 2; A = number of armature conductors; Φ = useful magnetic flux passing through the armature from each pole, 10^{-8} being the reduction factor as before.

As already premised, the flux, N, is not "from each pole," through the armature, but from north pole-piece, to south induced in armature, through to induced north on opposite side, then to the south pole-piece, etc.

Compare the formulæ applied to the one machine:

Formula (1), is..... $E = \Phi A n 10^{-8}$.

Formula (2), is.... $E = 2 \Phi A n 10^{-8}$.

The factors in each case are identical, with the exception that in the latter, we have a symbol, p, the number of poles, which equals 2, the introduction of which prescribes a doubled output for the machine, and instead of being a matter of "absolute indifference," it is in reality of especial importance. R. C. HARRIS.

TORONTO, CAN.

[It seems almost unnecessary to continue a discussion on a matter which is so simple. The editorial statement which Mr. Harris criticises appears on page 294 of the issue of March 11, and reads as follows:

"This is evident from the fact that the usual formula which expresses the e. m. f. of a dynamo armature is dependent upon the rate of rotation, the number of poles, the number of turns and the useful magnetic flux passing through the armature from each pole."

This statement is obviously correct and agrees with the formula which Mr. Harris says is correct. The e. m. f. is dependent upon the rate of rotation n. It is dependent on the number of poles p. It is dependent on the number of armature turns A. It is depnedent upon the useful magnetic flux passing through the armature from each pole Φ.

Consequently the e. m. f. is dependent up $\Phi A p n$

Mr. Harris says it is equal in a bipolar machine to

$$\frac{\Phi A p n}{2} \times 10^{-8} \text{ volts.}$$

So do we, and this is entirely consistent with our original statement above quoted.

As for the question of how the magnetic flux enters or leaves the armature, that is entirely a matter of convention. It is arbitrarily assumed to leave the north seeking pole, and return by the south seeking pole. Our statement is to be read with this understanding. —Eds.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Induction Motor.—The beginning of a reprint of an Institution paper the chief object of which is to describe his experimental investigations of the conditions on which the starting torque depends. He used a 15-hp motor on a 220-volt single-phase circuit. His experiments are described in detail and diagrams are given, but no conclusions are drawn in the present portion.—Wilson. Lond. *Elec.*, March 17.

Operating Dynamos in Multiple.—An explanation of the action of two continuous current dynamos running in multiple when not properly regulated; it includes an explanation of the action of the equalizer.—*Power*, April.

Direct Driven Set.—A brief illustrated description of a 360-hp direct-coupled engine and shunt-wound dynamo.—Lond. *Elec. Rev.*, March 17.

Dynamos for Electrolytic Work.—Brief descriptions of some large Swedish dynamos.—Lond. *Elec. Rev.*, March 17.

Design of a 1-hp Motor.—An illustrated description with working drawings of the various parts of a 1-hp continuous current motor.—*Power*, April.

LIGHTS AND LIGHTING.

The Nernst Lamp.—An article is begun by Mr. Hall in the Lond. *Elec. Rev.*, March 17, in which he compares the Nernst lamp with arc and incandescent lamps. He believes that the claims of the Nernst lamp must be modified. He thinks it can never compete with, or supersede, the arc lamp unless it can produce one-candle power with 0.4 watt; in that case it would supersede arc, incandescent and gas lights. At present he thinks it will not take the place of a single arc lamp as 3.6 times more energy is required per candle power (in which he assumes the 500 arc lamp to give 1200-cp, which seems to be crediting the arc lamp with too much candle power). Compared with the enclosed lamp the relation will be 1.6 as against 3.6 for the Nernst lamp. Calculations are made for the case of 20 arc lamps in parallel with transformers, from 2000-volt mains; the current will be 5 amperes in the primary, while for 20 Nernst lamps the current would be 36 amperes, involving seven times the cross-section of the wire in addition to the transformer to transform from 2000 to 1000 volts. An arc lamp complete costs about $30 and the Nernst lamp about $5. The first cost and maintenance for twelve months is calculated, the total being $165, while for the Nernst lamp it would be $440, the maintenance of the latter being taken as four times as great. For lighting large areas he believes the arc lamp will not be superseded, but for narrow streets, public halls, etc., the Nernst lamp will be a valuable acquisition on account of increased economy in running.—Hall. Lond. *Elec. Rev.*, March 17.

Mr. Dieudonne, of Paris, in a brief communication to Lond. *Engineering*, March 17, recalls an incident at the Paris Exposition of 1878 when Jablochkoff made the following experiment, which was witnessed at the time by that writer and several other persons. A thin rectangular plate was secured between two metallic plates connected to the terminals of an induction coil. Jablochkoff drew a line across this with a large pencil, the plate being apparently a piece of glazed porcelain. A luminous line followed along this path each time the operation was repeated, but the writer has no recollection that any incandescence followed. He believes, however, that Jablochkoff stated at the time that the porcelain ought to have lighted up and remained incandescent, and he considers this a good reason for believing that Jablochkoff had succeeded on a previous occasion in doing this.—Dieudonne. Lond. *Engineering*, March 17.

A brief description by W. S. F. of how to make a Nernst lamp is given in *Science*, March 24. He states that pure magnesia can hardly be started even with 1000 volts and a good blow-pipe. The conductivity of a rod may be completely controlled by mixing with the magnesia varying amounts of silica and fused silicates. A satisfactory lamp may be made as follows: Mix thoroughly pure calcined magnesia with 2 or 3 per cent. of powdered silica, 1 or 2 per cent. of magnesium sulphate, and 1 per cent. or less of sodium or metallic silicate (water glass); dry until just moist enough to pack under pressure; line a brass tube with stiff writing paper and tamp the mixture into this tube; then bake and lay the rod on a bed of magnesia, and by means of carbon terminals pass an alternating current through it, heating it first to redness with the blow-pipe. A hard and compact rod is thus formed and it may be ground to a thin rod with grooved ends into which the platinum terminals are wound; some water glass and powdered magnesia may be used to cover the platinum. Such a lamp is easily started, but its resistance rises with continuous use, owing perhaps to the volatilization of potassium or sodium silicate; calcium silicate, he thinks, might be more satisfactory. A striking experiment may be performed with a piece of glass tubing several inches long provided with copper terminals at the ends. At a low red heat it will begin to pass a considerable current with a few hundred volts and is quickly melted by the current.—*Science*, March 24.

Efficiency of 220-Volt Lamps.—Some tests were recently made in Germany to measure the life and efficiency of 220-volt lamps, a description of which is given in the *Elek. Rundshau*, and abstracted briefly in the Lond. *Elec. Eng.*, March 17. Lamps from six different makers, presumably all German, were measured at various ages up to 1150 hours. When new they consumed 3.8 to 4.3 watts per candle, the actual candle power of the 16-cp lamps being between 11.4 and 14.9-cp and that of the 10-cp lamps about 8-cp. After 600

hours the former consumed 4 to 5 watts per candle, the intensity varying between 11.7 and 14.2-cp, the test being therefore very unfavorable. The individual lamps from the same makers differed considerably both in candle power and efficiency. A variation in the voltage of 1 per cent. changed the candle power 6 to 7 per cent. Nothing is said in the abstract about the life.—Lond. *Elec. Eng.*, March 17.

Leading in Wires.—As has been noticed before, Mr. Guillaume has made extended researches with nickel steels. It appears from a recent abstract in *Science Abstracts*, February, that such an alloy may be made to have the same expansion as that of glass. In that case it might be used for leading in wires.

REFERENCES.

Arc Lamp.—What is said to be an entirely new departure in arc lamps in the form of the new Davy lamp of the enclosed type, is briefly described. No illustrations are given, and the description is not clear.—Lond. *Elec. Eng.*, March 17.

POWER.

REFERENCES.

Transmission and Application of Power.—A long illustrated article the object of which is to "set forth the modern status of those two branches of engineering." As illustrative of the recent development in transmission, three large typical plants are briefly described, one at Minneapolis, another at the big Cottonwood Creek and another in Ogden Canon, all of which use water power and three-phase currents.—*Power*, April.

Electric Pumps at Glasgow.—An illustrated description of the pumps referred to in the "Digest" last week.—Lond. *Elec.*, March 17.

TRACTION.

Traveling Platform.—A well illustrated description of the one to be constructed for the Paris Exposition is published in *L'Ind. Elec.*, March 10. An experimental line of about one-tenth the length has been constructed and operated; the length of the line at the Exposition is to be 4 km (2.4 miles). There will be two platforms, one having double the speed of the other, and in general the method seems to be similar to the one at the Chicago Fair. There will be 24 Alioth motors of the non-synchronous, three-phase, alternating current type, specially constructed. The question of starting is discussed at some length. While ordinarily such motors are started with resistances, a different method will be used in this case. The motors will develop 7.3-kw at 50 periods or 3.5 at 25 periods; they have four poles and a speed of 720 at full load; the starting couple is 2.5 to 3 times the normal couple. The motors are coupled in six groups of four in series in each group; the voltage is 200; they are so distributed that in case of failure of one series the inactive motors are distributed. The advantage over continuous motors is claimed to be the absence of brushes and commutators, which owing to the inaccessible position of the motors, is important; the present motors require no more attention than to keep them oiled. The generator is described and illustrated. For starting the platform, it is proposed to use a current of which both the frequency and the voltage gradually increase; when the voltage is 13 per motor, a starting couple is produced which is greater than the normal; at 75 volts it is 2.5 times the normal and the frequency is then 8 to 10 periods per second. At the start the generator is strongly excited, and the engine is gradually started; the starting current is 600 amperes at 75 volts; when the speed of the platforms has reached 8 and 4-km per hour, the voltage is about 150 and the frequency 20; at 10 and 5-km the frequency is 25. The normal speed is 8 and 4-km, at which the power is 58-kw, and this is almost independent of the live load, which increases the consumption only about 4-kw. The trials are said to have been very satisfactory.—*L'Ind. Elec.*, March 10.

Accumulator Traction for Heavy Railroad Work.—The Viennese journal *Zeit. fuer Elek.*, March 12, reprints a brief description of the Milan-Monza plant in Italy which was started on the 7th of March. On this line large accumulator cars are used; a car has two pivoted trucks, each with one motor; the cars are 17.8 m long, 2.5 m high and 2.85 m in width. The motors drive through a single reduction gear in the ratio of 61 to 20; the motors have four poles and are shunt-wound, the four coils being connected in parallel. Each car contains a large and a small battery, the former for driving the motors and the pump for the air brakes, while the latter is for lighting. The main battery consists of two sets of 65 cells, the two groups being connected in series or in parallel; during the greater part of the trip they are in series. One charge is sufficient for six trips, that is, three return trips; the distance between the two cities is 13 km and the mean grade is less than 1 per cent.; the total distance for one charge may be increased to 100 km (60 miles); the batteries are charged on the cars in somewhat more than one hour, by means of a motor-driven dynamo, the original current being a three-phase current at 3600 volts. The accumulators are in cases secured to the bottom of the car, thus preventing the acid fumes from entering the car itself. The car weighs 58 tons, 17 of which is that of the accumulators. The regular speed is 45 km per hour and the total distance, with two stops, is made in 20 minutes; the speed can be increased to 60 km (36 miles) per hour. The total cost of the car with all its appurtenances is $20,000. For the regular traffic eleven trains per day are run in each direction, for which the two present cars suffice, but probably six more similar cars will be ordered, so as to establish a similar traffic between Milan and Pavia. These cars may also be run to Como for the electrical exposition there. The fare from Milan to Monza is twelve cents first class and seven cents second class. So far the operation has been very satisfactory.—*Zeit. fuer Elek.*, March 12.

Accumulator Traction in Berlin.—It seems that there have been some unfavorable results in Berlin on the lines on which accumulator traction is used. The *Elek. Anz.*, March 16, in a short article shows that these unfavorable results have not been due to the system itself but to faults in the construction; partly also to the failure of the charging system. It has been claimed that the cars could not be stopped quick enough, and that this was due to their weight. In reply to this it is shown that the empty cars weigh 10.3 tons, the live load is about 3 tons and the battery 3.3 tons, or only one-fifth of the total weight, and that therefore the inefficiency of the brakes was not due to this slight increase in weight; the braking arrangements were not well constructed. There was a very disagreeable odor of acid, but this was due to the imperfect construction of the retaining boxes in which the cells are carried and to bad sealing of the cells. Owing to the improper operation of the central station, the cells have not been sufficiently charged on the portions of the road on which the overhead trolley system is used. The batteries were not properly proportioned to do the work, as they were too small; instead of 3.3 tons, about 4.5 tons should have been used. The fact that some of the cars have left the tracks is not due to the accumulator system.—*Elek. Anz.*, March 16.

Railway Statistics for Europe.—*L'Ind. Elec.*, March 10, publishes its annual supplement in the form of a large twenty-page table giving well filled columns of statistical information of all the electric railways in Europe at the beginning of this year. A summary is given at the end. The total length of lines is 2876 km, of which almost exactly one-half is in Germany, the next largest length being 488 km in France. The total power represented is 86,123-kw; the total number of motor cars is 5734. The total number of lines is 248, of which 73 are in Germany, 56 in France, 32 in Switzerland and 29 in England. Of these, 206 use the overhead conductor, of which 63 are in Germany, 42 in France and 32 in Switzerland. Ten lines use the central rail, of which 8 are in England. Fourteen use accumulators entirely, of which 6 are in France and 4 in Germany. Eight use the mixed trolley and accumulator system, 4 in France and 4 in Germany. Three use the combined trolley and conduit system, of which 2 are in Germany and 1 in France.—*L'Ind. Elec.*, March 10.

Cast Welding Rail Joints.—Dr. Goldschmidt, whose novel and interesting form of furnace was duly described in the "Digest" some time ago, referred in a recent lecture to its application for joining the ends of rails of street railways; this portion of the lecture is reprinted in the *Elek. Zeit.*, March 16 (see also "Digest," Feb. 25). It will be remembered that this method of fusing iron is to mix metallic aluminum with iron oxide and igniting the mixture, which will burn and yield metallic iron. To apply this to joining rails, the two rails are first pressed tightly together end to end; by the heat generated when the metal is cast around them, the expansion will then press them still tighter together, producing what is claimed to be a weld across the whole cross-section, as was shown by means of tests. For making the joint, a mould of thin sheet metal is laid around the joint and surrounded on the outside by sand. A mixture of ordinary iron ore with aluminum is placed in the crucible and is ignited, after which more of the mixture is added until the crucible is full; this requires a few minutes. For a rail of large cross-section, about 7 inches high, he states that 4-kg (8.8 pounds) of aluminum are required. The top of the crucible will be covered with liquid

corundum. The contents of the crucible are then poured into the mould around the rail, and it is said the liquid corundum first covers the rail with a thin coating, preventing the fused metal from "injuring" the rail by getting in contact with it. The slag formed, which is corundum, may be saved as a valuable by-product. The whole process is very rapid and simple; three men will suffice, and no transportation of apparatus or machinery is required other than the clamps, the crucibles and the raw materials. It seems that the crucibles require renewing frequently. Among the advantages of his method over the electrical welding system are that the heating of the iron around the joint is quite uniform and there is therefore no danger of burning; moreover the amount of heat can be accurately determined in advance from the mixture and quantity of the ingredients.—Goldschmidt. *Elek. Zeit.*, March 10.

Motor Carriage Design.—Mr. Parker, in a paper read before a Liverpool society, describes a motor car which he has built (referring apparently to a sort of omnibus); a brief abstract is given in the Lond. *Elec.*, March 17. This car weighed about 30 cwt., and carried nine people; it had two motors and 40 Blot cells arranged in two groups. The various speeds are obtained by various connections of the two groups of batteries and the two motors in series and parallel, there being apparently no resistance used. The steering gear moves both the front and hind wheels in opposite directions and at the same angle, which enables the car to be turned in its own length without turning the wheels under the body, and it is double as sensitive as the usual arrangement. It was found to be difficult to brake the car on steep down grades, and the motors were therefore rewound for shunt excitation; instead of the sudden rush of currents at starting, with the series motors, namely, 50 amperes, the car moved steadily with less than 10 amperes, although the current was about the same at greater speeds. The work of manipulating the car was very much reduced, as it was necessary only to set the apparatus for the required speed; on ascending the steepest hill the speed did not increase 5 per cent., the batteries being charged with 20 amperes. The car could be brought to a stand from full speed in three feet on a 10 per cent. grade without the use of the brake or reversing the motors, which is impossible with the series winding. The original car has been running daily for eighteen months without a single breakdown.—Parker. Lond. *Elec.*, March 17.

REFERENCES.

Automobiles.—The first part of a long article on the present standing of the automobile industry. This portion refers to the motive power and is largely descriptive of various forms of mechanical motors, illustrations of which are given. In conclusion the electric motors are briefly but not unfavorably referred to.—Lavergne. *Rev. Gen. des Sciences*, Feb. 28.

Butte-Centerville Railway.—An abstract of a recent paper describing that electric road.—Blackford. *Eng. and Min. Jour.*, March 25.

Blackburn.—A detailed description with many illustrations, of a short four-mile road which has just been completed.—Lond. *Elec. Eng.*, March 17.

Installations, Systems and Appliances.

Charging Accumulators with Alternating Currents.—An apparatus was recently described in a paper read before a German society, an illustrated abstract of which is given in the *Elek. Zeit.*, March 16. It consists merely in a rapidly vibrating switch which is vibrated by an alternating current magnet; it closes the circuit only when the current is in one direction. Numerous tests with this apparatus are said to have shown that it is quite reliable (but nothing is said about the sparking). A similar apparatus is also used for running continuous current motors from half of the phases of an alternating current. By combining two such apparatus with a battery divided into two halves, the whole of the alternating current can be used. The apparatus has been in use for some time for charging 36 cells in the Frankfort opera house with a current of 60 amperes, and it is thought that it might be used ever for greater currents. Dr. Déguisne stated that he had measured the efficiency of the apparatus and found it to be 93 per cent. when used for charging accumulators and 80 to 90 per cent. when used for incandescent lamps. The illustrations are mere diagrams and show no details or proportions.—Behrend. *Elek. Zeit.*, March 16.

Wires, Wiring and Conduits.

Insulation Rules.—Some of the rules of the American Underwriters' National Electrical Association are briefly discussed editorially in the Lond. *Elec. Rev.*, March 17. By these rules it is permissible to use a quality of rubber inferior to that generally used by the English, the insulation specified being somewhat lower and the thickness as a rule greater. It is thought that this is not a step in the right direction, as the quality and consequently lasting powers, is the first consideration, and with good quality less thickness may be used with better results. It is thought that the English rule is preferable to this American one, as the thickness of the dielectric does not vary by leaps and bounds, but progresses steadily at the rate of 31 added to a tenth of the diameter in mils. It is also thought preferable not to use large solid wires, but to discard everything larger than a No. 12. English manufacturers are thought to lead by giving a certificate with all coils.—Lond. *Elec. Rev.*, March 17.

REFERENCES.

Wiring Rules.—A brief discussion of the modification of the English Institution rules which it has been proposed to adopt as standard.—O'Gorman. Lond. *Lightning*, March 9.

Insulators.—Brief illustrated descriptions of a large number of different forms of insulators.—*Power*, April.

Electro-Physics and Magnetism.

Electrolytic Conduction Without Electrodes.—It has been suggested a number of times that interesting results might be obtained with a tube or trough containing an electrolyte, and surrounding a transformer so that the electrolyte forms a complete circuit just like a short-circuited coil, in which currents are induced; in such a case alternating currents will flow through the electrolyte without the necessity of any electrodes. Mr. Behn-Eschenburg, in the *Zeit. f. Elektrochemie*, March 2, describes briefly with the aid of an illustration, some experiments made with such an arrangement. A horizontal, rectangular trough was made to fit around the core of a transformer and was filled with an electrolyte which thus formed a short-circuited liquid coil in which currents were induced. Into this trough the terminals of a voltmeter were inserted at fixed distances, from which, knowing the current, the resistance could be calculated. Immediately above the trough was a single winding around the same core, the voltage of which was also measured, and this showed the total voltage which was induced in the trough of of liquid. His experiments, which were only approximate, were made to find whether the resistances thus measured agreed with those measured in the usual way, and the experiments gave favorable results. The trough was made of wood so as to be a non-conductor. Besides the trough there was a single winding of a resistance wire which had approximately the same resistance as that of the liquid, thus enabling comparisons to be made with the resistance of the liquid and that of this wire. The results showed that comparisons could be made in this way and that the behavior of the liquid was like that of a solid conductor.—Behn-Eschenburg. *Zeit. f. Elektrochemie*, March 2.

Anode Rays.—The French physicist, Broca, in a recent paper in *Comptes Rendus*, Feb. 5, abstracted briefly in Lond. *Elec.*, March 17, describes experiments in which he obtained anode rays. Two pointed electrodes of platinum were mounted very close together in a vacuum bulb. Ordinarily the disintegration is found at the cathode which is due to the fact that the potential gradient is steepest there, but in the present tests the potential gradient seems to have been concentrated near the anode from which the metal escaped and was projected with considerable force on to the glass wall. A magnetic field deflects these rays in the opposite sense to the deflection of cathode rays; they show a left-handed screw motion while the cathode rays show a right-handed twist.—Broca. *Comptes Rendus*, Feb. 5.

Wave Detector.—Dr. Lodge, in the Lond. *Elec.*, March 17, suggests as an explanation of the Neugschwender wave detector (see "Digest," March 25), that it is simply an ordinary coherer in which the continuous film aggregates into globules under the electric influence, thus breaking the continuity.—Lodge. Lond. *Elec.*, March 17.

REFERENCES.

Secondary X-Rays.—Descriptions of experiments which appear to show the presence of secondary X-rays which are capable, like ordinary light, of neutralizing the photographic effect of X-rays.—Sagnac. *Comptes Rendus*, Jan. 20; abstracted briefly in Lond. *Elec.*, March 17.

Source of Atmospheric Electricity.—Descriptions of some experiments.—Pellat. *Comptes Rendus*, Jan. 16; abstracted in Lond. *Elec.*, March 17.

Conductivity of Permanganate of Potash Solutions.—A list of the

determinations of Legrand at various concentrations.—*Elektrochem. Zeit.*, March.

Magnetic Energy.—A theoretical article in which are compared the equations of Maxwell and of Hertz for bodies in movement, and those for the magnetic energy and the magnetic forces produced by a field. There are several discrepancies which he explains.—Poincare. *L'Eclairage Elec.*, March 11.

Electro-Chemistry and Batteries.

New Calcium Carbide Process.—A new process by Gin and Leleux is described in *L'Ind. Electrochimique* 2, p. 9, abstracted briefly in *Elektrochem. Zeit.*, March. Cast iron and coke are "fused together" in an ordinary smelting furnace and the melted mass is then run into an electric furnace where a certain amount of lime is added and an electric current passed through it, the iron forming the cathode and retort carbon the anode.—*Electrochem. Zeit.*, March.

References.

Acid for Accumulators.—A brief notice of his expired German patent of 1881 for obtaining pure sulphuric acid. He calls attention to the very great importance of pure materials in accumulators. Impurities of 0.1 per cent. in some cases are said to be ruinous to the accumulator.—Borntraeger. *Elektrochem. Zeit.*, March.

Extracting Metals from Ores.—A short criticism, partly unfavorable, of the paper of Hoepfner, an abstract of which was given in the "Digest," Nov. 26.—Borchers. *Zeit. f. Elektrochemie*, March 2.

Analysis of Copper Slimes.—An abstract, in German, of Hollard's recent article.—*Zeit. f. Elektrochemie*, March 16.

Carbide of Calcium Plants.—A list of the plants in various countries, which is supposed to be complete.—*L'Ind. Elec.*, March 10.

Units, Measurements and Instruments.

Wehnelt Electrolytic Interrupter.—Some further information concerning this interrupter is given in a Physical Society paper by Mr. Swinton which is abstracted in the Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, March 17. He used a solution of one part of acid in five of water. The platinum wire projected from the top of the shorter arm of a J-shaped ebonite tube, thus pointing upwards; it is surrounded by a cylindrical negative electrode of lead. He prefers an ebonite tube for the anode terminal, as glass is apt to crack. The interrupter requires rather a strong current; the resulting spark is almost uni-directional. As the self-induction is diminished the spark pitch rises and becomes infinite when the self-induction vanishes, that is, the interrupter will not work when there is no self-induction in the circuit. He found that 25 volts was the maximum primary voltage for his apparatus. The pitch also varies with the length of the platinum wire in the solution. If the circuit is closed by dipping this electrode into the solution the apparatus will not work, as the wire must be immersed before the circuit is closed; (the compiler has found that this is not necessarily the case). The action often ceases after working for a quarter of an hour; this fatigue effect is not due to the heating of the solution as it is not obviated by keeping the temperature constant by a water bath. It is thought that the oxygen film generated on the platinum electrode forms an insulating film which interrupts the current. The fact that oxygen is more easily absorbed than hydrogen may explain why it is necessary to connect the platinum electrode to the positive pole. When the platinum is immersed gradually it gets red hot and there are no interruptions. When the apparatus stops from fatigue the platinum also gets red hot. The apparatus would be very effective for Roentgen ray work, but the sparks produce great heating. As sparks are more nearly continuous than ordinary discharges, they might produce Hertz waves which are less rapidly attenuated than those now applied to wireless telegraphy and the trains of waves would follow at shorter intervals than with the usual methods. In the discussion Prof. Lodge said there was undoubtedly capacity at the surface of the platinum and this acted with the self-induction, so that there was an automatic adjustment of resonance. Prof. Minchin suggested that the apparatus would be much more useful if it could work with less current. He had succeeded with 12 volts. In using a horizontal lead plate explosions were frequently obtained. There seemed to be a definite depth of immersion of the wire at which the apparatus worked at a maximum current. He attributed the fatigue to the presence of gas about the electrodes, as he found that a mechanical tapping of the apparatus restored the working conditions. Mr. Appleyard suggested that the liquid immediatley around the wire was in a spheroidal state and that therefore the capacity for heat of the non-immersed part, and the degree of smoothness of the immersed part, seem to be factors in the explanation of the action. The evolved gases are no doubt the primary cause of the interruption. Mr. Blakesley stated that the rise of potential at the terminals of the interrupter proved that it possessed capacity. Mr. Morris described experiments with such an interrupter and a 1-kw transformer. The anode was made to have an adjustable surface, the platinum wire being projected more or less through the lower end of a glass tube containing oil. He found that the fatigue of the interrupter could be remedied temporarily by reversing the current. Swinton in his reply said that with an alternating current only about half the effect was produced as with the continuous and apparently only half the alternations got through; but if two were connected in parallel it was possible to make one take one-half and the other the second half of the alternations and it might therefore be possible to design a coil with two primaries so as to give an additive effect. He could not overcome the fatigue by mechanical means. Prof. Lodge did not think Hertzian telegraphy would be improved by using these interrupters. The frequency of the interrupter was about 1000, but that of the Hertz' waves was about 100,000; the wave trains would therefore still be a series of damped vibrations.

The apparatus was also exhibited by Mr. Swinton at the English Institution. He thought the apparatus might be used for producing more continuous trains of Hertzian waves. With a Tesla coil the waves lasted a fifty-thousandth of a second and were followed by intervals of a 200th of a second showing a very great gap between the waves and for this reason it is difficult to syntonize them; but with this interrupter discharges of one thousand or more per second are easily obtained. He used one part of acid to five of water. He connected the apparatus directly to one hundred-volt circuits; the apparatus will not work if the lead plate is positive. The explanation offered, that the interruptions are due to the film of oxygen, did not cover the facts; he could not offer a better one. An arc was formed at the end of the platinum wire and the apparatus would not work on the non-inductive circuit, as for instance if a lamp is inserted instead of an induction coil. He thinks it is the first real advance made for many years in continuous current interrupters at high frequencies. The temperature had considerable to do with the action. Prof. S. P. Thompson said that there was something in the nature of resonance taking place, the platinum point having a capacity. He stated that Prof. Sloughinoff had shown in 1881 that with a sufficiently high e. m. f. in such an apparatus, the current was intermittent.—Lond. *Elec.*, March 17.

A French Academy paper by Dr. d'Arsonval reprinted in *L'Ind. Elec.*, March 10, *L'Eclairage Elec.*, March 11 and *L'Elec.*, March 18, contains a description of his experiences with that apparatus, which he praises very highly. With a small coil giving only a 4-cm spark he obtained a frequency above 3000 per second. The frequency depends on the self-induction, the dimensions of the platinum wire and the voltage. He also used the alternating current at 110 volts and found that it worked equally well, but that the interruptions were made only in one direction, the apparatus being therefore at the same time a separator of the currents, which is important in radiography. With the Berthelot ozonizer very much greater quantities of ozone were produced than with the ordinary interrupter. The curve of interruption shows that they are very regular, that there is no time lost nor are there parasitic oscillations. He believes the best form is a tube of very thin glass, the platinum being fused to the end, which should be very thin and the tube should contain mercury. He did not obtain such good results with porcelain. Instead of acidulated water he used a solution of potash with equally good results, and the advantage that the vessel may be of iron. Applied to his high frequency medical apparatus the same coil gave results ten times as energetic as with the Foucault interrupter. He believes that the action is due to the formation of a layer of vapor which insulates the point; this is then condensed, which re-establishes the current; the proof is that when the liquid heats to near the boiling point the apparatus stops, as there is then no condensation. Around the platinum there is also generated an explosive mixture of hydrogen and oxygen due to the dissociation of the water by the heated platinum. This explains why the interruption of the alternating currents takes place only in one direction; when the platinum point is positive, it reddens more quickly than when negative; although there is an interruption it is much slower and the voltage of the induced current is therefore less. The construction of the coils should evidently be modified to adapt them to this new interrupter; among other things he suggests insulating the coils in a liquid or paste insulator. He remarks that in 1892

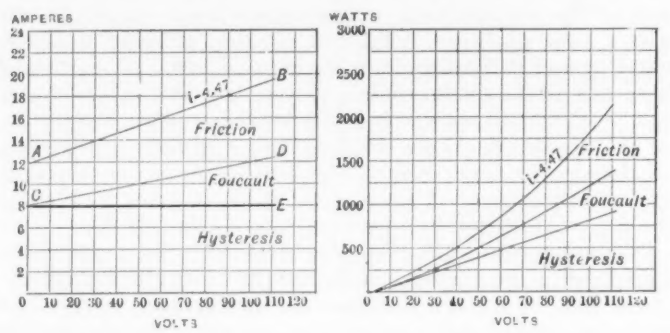
Koch and Wuellmer showed that the current through such an apparatus was intermittent.

In a communication to the Lond. *Elec.*, March 17, Prof. S. P. Thompson described some experiments from which he concludes that the phenomena is essentially one of resonance and depends on the presence of self-induction in the circuit and on the capacity of the platinum anode. He referred to the tests of Sloughinoff of 1891 (see above). The frequency can be varied by changing the size of the anode and by varying the self-induction. Two interrupters in series act in general like a single one of half the capacity. The regularity of the interruptions is improved if a jet of acid flows rapidly past the anode so as to remove the bubbles. If the pressure on the liquid is raised, the "current passing through the break" increases; for an increase of from one to three atmospheres, the current changes from five amperes to six, the frequency decreasing. A choking coil was connected in series with the interrupter across the hundred-volt lightning mains and a one-hundred and fifty-volt lamp in parallel with the choking coil was well illuminated. In another experiment the voltage was raised to 139. The voltages across the interrupter and the choking coil when added together always exceed that of the mains, provided a suitable voltmeter is used. With proper adjustment they may each separately be greater than the original voltage.—S. P. Thompson. Lond. *Elec.*, March 17.

In a communication by Dr. Fleming he describes some experiments. The flame produced by the induction coil was that of burning nitrogen. With an adjustable non-inductive resistance and a choking coil the number of discharges may be varied from one to two per second up to a thousand or more. A choking coil of high inductance and very low resistance is the best, the required non-inductive resistance being external to the choking coil. The discharge is quite startling if some large Leyden jars and are connected to the terminals of the coil. The effect is still further increased if in addition a Tesla coil is used to take up the oscillatory discharge of the jars. The e. m. f. of the secondary circuit of the Tesla coil is also greatly increased, so much so that great caution must be exercised. The positive electrode is best made with a stout copper wire through a narrow porcelain tube, the platinum wire being welded to the end and protruding through an ebonite plug at the bottom of the porcelain tube. If the wire is welded in a glass tube it gives endless trouble by breaking out.—Fleming. Lond. *Elec.*, March 17.

In a communication from Mr. Beattie he drew an analogy between this apparatus and the reed of an organ pipe. There is a production by electrolysis of a mixture of hydrogen and oxygen at the anode which gave rise to minute explosions, which he thinks explains the action. The frequency can be deduced from the current and the e. m. f. at the condenser terminals, and from experiments he finds that the frequency so determined is independent of the pitch of the note emitted, and depends only on the capacity and the self-induction. He has obtained frequencies up to 4000 per second. By placing a coil in series with the condenser and dynamometer and measuring the e. m. f. at its ends as also at the condenser, an approximate value of the self-induction of the coil may be obtained, thus offering a means of measuring self-induction.—Beattie. Lond. *Elec.*, March 17.

Separation of the Hysteresis, Foucault Current, and Friction Losses.—A long article is begun in the *Elek. Zeit.*, March 16, in which Mr. Dettmar describes his method of separating these losses in measurements of dynamos and motors. Although not so stated, it appears from the method that it is applicable only to continuous current machines. The method seems simple, but appears to involve the exterpolating of values obtained by continuing certain curves beyond the values obtained experimentally. These three losses can be measured only as one whole quantity and can then be separated only by the different variations of the three quantities due to different speeds and field strengths. The only method now known for separating them, is said to be the one described by Hummel in 1891 and consisting briefly in measuring the no load energy for a constant field of strength and then for a constant speed; but in separating the quantities in these results, the assumption is made that the loss due to bearing friction is proportional to the speed, and that the loss due to air friction may be neglected; the first assumption, however, is not allowable, as considerable errors are introduced thereby. For approximate determinations of the efficiency of a belt-driven machine, these errors need not be considered, as in the final result they approximately balance each other, as the first loss will be about as much too large as the other is too small. Important errors, however, may be made with a direct-coupled machine, as the friction will then include that of other parts combined with the dynamo. It appears to be assumed in his tests that in such cases all parts of the engine ordinarily connected with the shaft are disconnected so that only the friction of the additional bearing is included. In the predeterminations of the temperature and other quantities it is important to be able to make accurate tests, as the accuracy of the determination of the iron losses will depend upon that with which the friction losses can be determined. He has used his method for a number of years in practice and has always obtained good results. Briefly described, the method consists in running the machine as a motor at constant speed but with different voltages, and measuring the loss in watts. (Although not so stated, he evidently means running it unloaded). This is done for several speeds, some below and some above the normal. The results are then plotted as curves, the ordinates being watts and the abscissas volts. These curves are then extended to the ordinate representing zero voltage, thus giving the losses due to friction at the respective speeds; the tests should therefore include one at the lowest possible voltage at which the machine will run (this seems to be the weak point in the method, as these curves have their greatest curvature at very low voltages, and therefore much depend on the lowest values in the test). The curves are of a quadratic nature, which fact may be used to assist in this exterpolation; the energy delivered to the motor is equal to that lost by friction added to the product of the square of the voltage and a constant (but what this constant is, is not stated). Laying out these friction losses as a function of the speed, a curve will be obtained which is not a straight line but has a decided curvature. Having determined the friction for all speeds, the iron losses should be divided into those due to hysteresis and Foucault currents. For this purpose the machine is run at constant field strength and at different voltages, the current required in each case being measured (the machine being presumably run again as a motor and unloaded). These are then laid off, as shown in the first of the



accompanying figures, as a function of the voltage, and the results will, as a rule, form a straight line, although that is not always the case. Formerly it was assumed that the current in this diagram for zero voltage, corresponds to the losses by friction and hysteresis added together and that this value remains a constant. This is true for hysteresis as was shown by Steinmetz, the hysteresis loss being proportional to the frequency; but it is not true for the friction. But from the second curve described above but not reproduced here, giving the friction losses as a function of the speed, the current required by the friction can be calculated for several points, by dividing the loss in watts by the corresponding voltage for that particular field strength and corresponding with that speed; in this way the line *C D* in the first of the adjoining figures is obtained, and its intersection with the vertical zero line will give the current corresponding to the hysteresis loss. Drawing a parallel line through *C*, the ordinates between *C D* and *C E* represent the currents corresponding to the Foucault current losses. A better idea of the relations is obtained in the second figure in which the losses are represented as a function of the voltage. The first of the two figures makes the determination of the hysteresis losses simpler, as the latter figure involves drawing a tangent, while in the first one this is a parallel line, which is much easier drawn. Having separated the hysteresis and Foucault losses in a number of cases, the iron losses at a constant speed, may be separated, and in this way the efficiency for any desired speed may be calculated. After this brief description, he begins a discussion of the details. The first tests may be greatly simplified, as it is not necessary to determine both of the first groups of values for constant speed and constant field strength, as many measurements would thereby be duplicated; it

suffices to determine only the curves at constant excitation and then calculate the other from this; it is much simpler to keep the excitation constant than the speed. It is necessary then, however, to wait until the motor is running normal; moreover the test should not be made until the bearings have assumed a constant temperature, which sometimes requires several hours; this is especially the case with new machines. For very exact tests it is, moreover, desirable to use accumulator currents as they are steadier. The description is to be continued.—Dettmar. *Elek. Zeit.*, March 16.

Improvement in the Sullivan Galvanometer.—A modification which is said to be of considerable importance is described briefly in the English journals March 17, the object being to make condensers unnecessary when signaling through cables, even when they are quite long. With ordinary galvanometer receivers, a condenser was required on long cables in order to secure good definition of the signals. Trials made with a submarine cable 3000 miles long are said to testify to the success of this arrangement, excellent signals being obtained, when with ordinary mirror galvanometers the signals were quite unreadable under the same conditions. This improvement is secured by an alteration in the control and the electromagnetic and mechanical damping of the suspended coil; the modification involves only the addition of a special suspension frame. No further description is given.—Lond. *Elec.*, *Elec. Rev.*, and *Elec. Eng.*, March 17.

Standard Cells.—The comparative figures of the Clark and the Weston cells as determined by Jaeger and Kahle, recently noticed in the "Digest" are reprinted in the Lond. *Elec. Rev.*, March 17.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—A long abstract of the discussion of Marconi's pape: (see "Digest," last week), is published in the Lond. *Elec.* and partly in the *Elec. Eng.*, March 17. Dr. Fleming referred to the use of oil in the spark gap; he himself had obtained unfavorable results. He confirmed the remark that the coherer was not an uncertain and treacherous instrument. Amalgamating the metal had an advantage. Mixing about 5 per cent. of finely powdered uranium with the nickel filings made the coherer more sensitive and certain. He thought it was certain that satisfactory transmission over long distances was due to Marconi's vertical wire; he himself had made experiments with both horizontal and vertical wires of the same length, which were favorable to the latter. Mr. Sullivan inquired whether a perfect earth connection was required, and referred to the difficulty in maintaining such a connection in some places, as along the coast. Captain Brett had in one case disconnected the earth connection from the receiver, but the signals came just as before, showing that the earth connection in that case at least was not a necessity, at any rate for a twelve-mile transmission. He believes, however, that the earth connection at the transmitter is a necessity, as it causes the discharge to be oscillating. Mr. Gavey referred at some length to the experiments which he had made in connection with the postoffice. Experiments had proved the law of the square of the height of the wires; they had also found that within certain limits the distance increased as the product of the two vertical conductors of different heights. There was a marked effect on the syntony if a capacity is placed at the top of the vertical conductor; a less height would then also suffice for the same distance. A greater height was required for signaling "over land below the sea level" (apparently a misprint); it had been calculated that the conductor for a certain case should be 35 feet high for transmitting over a mile of water, but they found it had to be 50 feet high. They found that there was a distinct difference in power required for transmitting over land as compared with that required over water. He suggests that it is due to the reflection from the surface of the water. When a capacity was substituted for the earth at the coherer end, the signals were equally good; at the transmitting end, however, good results could not be gotten without an earth connection. If a sufficient capacity had been used to dispose of the large amount of energy sent into the transmitting wire, then probably no earth would have been required at either end. They found that oil in the transmitter of the Righi form was quite superfluous, a single air gap being all that was necessary. Concerning the amount of energy required, he thought it was rather a question of frequency than of power. He thinks that signaling by means of reflectors would be far more satisfactory than with vertical conductors, especially when messages were being transmitted between various different stations, in which case all receivers would hear each transmitter, if reflectors were not used. An important point is the protection of the installations from the effects of lightning, as the vertical wire was practically a lightning conductor. Mr. Miller suggests the use of several spark gaps in series. Prof. S. P. Thompson thought the earth below the vertical conductor played a part analogous to that of a mirror, thus doubling the effective length of the vertical rod. The greater absorption of the waves over land as compared with water might be due to the conductivity of the earth being greater than that of water. The subject is also discussed editorially.—Lond. *Elec.* and *Elec. Eng.*, March 17.

Wireless Telegraphy.—Mr. Viles, in the Lond. *Elec. Rev.*, March 17, quotes a passage from the *Telegraphic Journal*, 1879, p. 87, in which Prof. Loomis was said to be continuing his experiments in telegraphing through the upper air by means of "natural currents of electricity" and without the use of wires. He built towers on the tops of West Virginia mountains twenty miles apart and erected metal rods to pierce the strata of the air; with telephones in this circuit it is said he could converse a distance of twenty miles.—Viles. Lond. *Elec. Rev.*, March 17.

The K R Law.—The conclusion of his mathematical article. No general conclusions seem to be drawn.—Moon. Lond. *Elec. Rev.*, March 17.

An editorial reference to this article states that the serious discrepancy between the conclusions of Lord Kelvin and Mr. Blakesley, rests on a mistake by Mr. Moon, who has not quoted Blakesley with sufficient care; this error deprives Moon's calculations of any value, but it has led him indirectly into a discussion of the exact meaning of the K R law, which is a point of some interest. The conclusions of the ordinary theory of the propagation of alternating currents through a cable are briefly given; the attenuation of the current is shown by the equation to depend on the product of the capacity and resistance, and on the frequency of the alternation, which leads directly to the proposition that the rate at which a series of charges may be passed into a cable to produce a certain effect at the far end is inversely proportional to the K R. It is also argued that it is not well to assume a fixed voltage and then determine the diameter of the conductor; if anything should be defined other than the sending charges, it should be the strain on the dielectric at the sending end, which would involve a reduction of the battery power with a reduction of the thickness of insulation.—Lond. *Elec. Rev.*, March 17.

Railway Telephony.—Referring to a recent article on some trials of simultaneous telegraphing and telephoning over the wires of the Chicago Great Northern Railway Company, Mr. Spagnoletti, in the Lond. *Elec.*, March 10, claims that the Americans "are evidently a long way behind" the English in this. Some five years ago he tried experiments in that direction on the phonophore principle and devised an instrument which has been working successfully for the last three or four years on many lines of railways in that country and on the continent.—Lond. *Elec.*, March 10.

References.

Wireless Telegraphy.—A reprint in full of the paper abstracted in the "Digest" last week.—Marconi. *Sc. Am. Sup.*, April 1.

Wireless Telegraphy.—A brief historical summary of the early experiments in this line beginning with those of Morse in 1842 up to those of Somzee and Edison in 1870.—*Elek. Zeit.*, March 16.

Telegraphs and Telephones of the World.—A reprint of the table of statistics from the *Jour. Telegraphique*, which was noticed in the "Digest" some months ago.—Lond. *Elec. Rev.*, March 17.

Vacuum Telephone.—Since the appearance of the article noticed in the "Digest," March 18, there has been considerable discussion in the Lond. *Elec. Rev.* concerning this microphone, the journal itself discussing it unfavorably. The issue of the 17th contains a reply by the inventor.

Miscellaneous.

Shop Uses of the Welding Transformer.—A few suggestions showing how a welding transformer previously described in that journal can be used for various other purposes, as, for instance, for annealing, brazing, soldering, etc. The shank of a tap or reamer may readily be annealed in this way. A small die can be annealed by screwing it on a thick copper rod which is capable of conducting away any heat that may be formed in the teeth themselves; the current is passed over the die from edge to edge, and as the copper rod will lead off the heat from the teeth, the color will appear there last and the hardness will be graded from the teeth to the outer edges of the die, a very desirable condition which it is impossible to obtain by any other means. A hardening plate may be annealed locally for

purposes of drilling and tapping (a process which was described some years ago for use in connection with armor plate). Brazing is best effected by passing the current directly through the joint to be brazed.—Hanchett. *Amer. Mach.*, March 23.

Gas Engines For Electric Lighting.

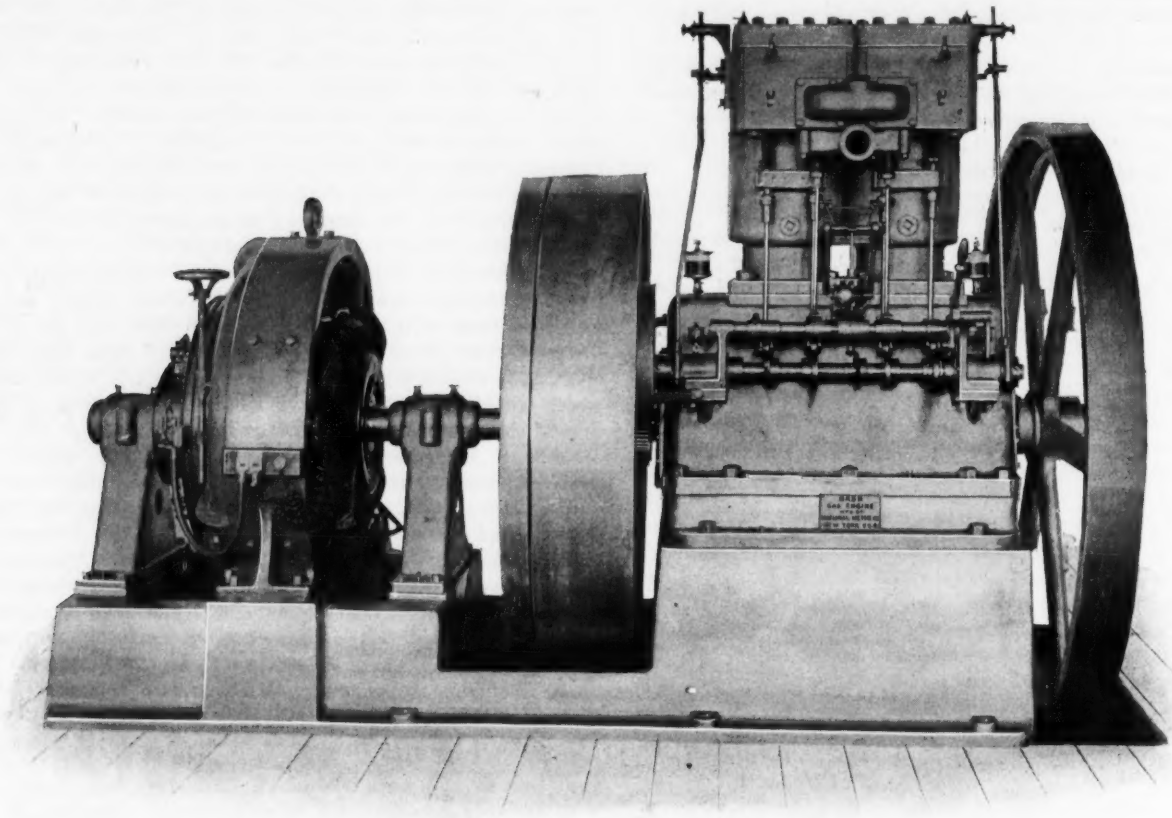
By James M. Cremer.

Considerable interest is now being shown in high-grade gas and gasoline engines for power, pumping and electric lighting. For electric lighting particularly the performance of such engines has been so satisfactory that electricians, engineers and architects are looking into the matter to a much greater extent than formerly, and the result must be when the principles of operation and the merits of these motors are as well understood as in the case of steam, that a great many of them will be installed. This will be more particularly the case for country places where gasoline engines may be operated in conformity with the underwriters' requirements, thus rendering possible at very moderate cost, the installation of complete electric light and power plants for hotels, club houses and private dwellings, putting them on a plane of equality with buildings of like character in the city where street current or isolated steam plants are available. But even for city service, using ordinary illuminating gas at prevailing rates, the gas engine makes an excellent showing, and many of them are now in use.

Herewith is shown a 300-light direct-connected plant operated by a Nash gas engine of 30 actual horse power. The dynamo is of standard slow-running type of 20-kw capacity, and both engine and dynamo are mounted on an extended bed plate, having outboard bearings to receive the dynamo. The whole forms a simple, compact unit, requiring but about 6 feet by 9 feet 3 inches floor space, and may, therefore, be installed where it would be impossible to locate a complete steam plant of equal capacity. The efficiency of the dynamo in this combination is about 80 to 85 per cent., according to the type of machine. The leading electric manufacturing companies have now a line of slow-running generators and can readily meet the requirements of direct connection for such units, which in the case of the Nash engine plants, range from 100 to 500 or more lights capacity.

Alluding to what we stated at the outset, about the increased interest now being taken in the gas engine, it is found that the general principles upon which such engines operate are not generally understood, but only by those who have given some study to the subject. With steam engines, on the contrary, engineers, manufacturers, business men and even the general public are familiar. What, therefore, would seem superfluous in the case of steam, and to gas engine experts as regards that motor, may yet be welcome to many who are not well informed about gas engines. The Nash gas engine, and others of the same class, operate by what is known as the four-stroke cycle. The engines are single acting and, according to this system, require four strokes of the piston to complete the following round or cycle of operation for each charge of mingled gas and air admitted to the cylinder.

During the first or downward stroke of the piston, a charge of gas and air mixed in proper proportions is drawn into the cylinder by the pumping action of the engine. During the second or return stroke, this charge is compressed to perhaps 80 or 90 pounds, the degree of compression for best economy and durability of the engine being carefully determined when the engine is designed, and then always maintained. At the beginning of the third stroke the charge is ignited and rapidly expands, propelling the piston under a heavy pressure which the vertical type of engine, transmitting, as it does, the strains direct to the foundation, is best fitted to resist. At the fourth stroke the exhaust valve opens, and the products of combustion escape through the exhaust pipe which is commonly carried up through an ordinary flue or chimney to above the roof.



Gas Engine and Dynamo Combination.

The same round or cycle of operations is then repeated, subject, however, to such modification as needed to preserve steady speed.

Regulation of speed in the Nash engine, under varying loads, is accomplished by a sensitive centrifugal governor, of either the shaft or fly-ball type, which so controls the lift or opening of the gas valve as to either admit or exclude gas for each cycle, according to the work demanded of the engine at each instant, thus securing, at once, close regulation and the highest economy in gas consumption. This method of governing by missed ignition, popularly known as the "hit and miss" system, enables the engine to produce always the same power card, to preserve the correct proportions of gas and air, and also that degree of compression suited to the highest economy combined with durability.

The vertical type of frame adopted for the Nash gas engine secures several important advantages, among which may be mentioned compactness, simplicity and the ability to use higher rates of

speed on account of better balancing and the fact that strains and vibration occur vertically and are transmitted direct to the foundation. There is also less friction and wear to a vertical piston than a horizontal one, and the vertical frame enables the crank shaft, crank pins, main bearings, connecting rods and lower end of piston to be enclosed by the frame which contains oil in the base, the oil being thrown over these working parts by the motion of the engine, securing at once thorough lubrication, economy in oil and protection from dust. A large door inside of the frame renders the main working parts immediately accessible when required.

The valve motion of the Nash engine, as shown by the cut, is external, and in plain view for examination or adjustment. There is a horizontal cam shaft provided to operate the valves, which are all of the poppet type. The shaft is driven from the main shaft by a pair of cut gears, and it carries the eccentrics for operating the electric igniters, also a connection to operate the gasoline pump for gasoline engines. The igniters are of simple construction and are so arranged that they may be quickly removed for examination and replaced by new ones when the electrodes are worn out. An external adjustment enables the point of ignition to be changed while the engine is running or the igniters may be thrown out entirely and the hot tube igniters put in service if desired. The regulation in speed with the Nash gas engine is within 2 per cent. from full load to no load. While this regulation is very close, it is still not in itself sufficient to adapt the engine to direct-connected plants, for arc and incandescent lighting, where the highest results are demanded. It may, therefore, be of interest to point out what is lacking in this direction and the remedy finally adopted.

Compared with a steam engine which admits steam at every stroke, and therefore, exerts an effort on the crank shaft twice in every revolution, the action of a single-cylinder gas engine, having only one power stroke in four, and therefore exerting an effort on the crank shaft only once in two revolutions, seems very irregular.

This circumstance, it may here be remarked, accounts for the striking difference in size between a steam engine and a gas engine of given power. Roughly speaking, the steam engine has a mean effective pressure of about forty pounds that is available every stroke, while a gas engine may have eighty or more pounds mean effective pressure, but can utilize it only once in four strokes. The gas engine must, therefore, be at least twice as large and heavy as the same power steam engine, but, besides this, the initial pressure of the working gas, which may be about 90 pounds in the case of the steam engine, is upwards of 350 pounds for the gas engine. Such higher pressures require a corresponding increase in size and strength of crank shafts, crank pins and other working parts, which serve to show in part at least where gas engines are more expensive to build than steam engines. They have, in fact, to fulfil the double function of developing and utilizing the power contained in gas and do so under far higher pressures than the ordinary steam engine and boiler are called upon to perform.

The irregularity of the impulses in gas engines, due to the causes mentioned, may be lessened in amount and be more evenly distributed throughout a cycle of operations, or during two revolutions, by increasing the number of cylinders. Thus, with two cylinders there will be two impulses in two revolutions, with three cylinders three impulses and with four cylinders four impulses on the crank shaft during two revolutions. Such an arrangement helps out the regulation but there is still the heavy impulse at each power stroke which is felt in the lights with a direct-connected lighting plant operated by a gas engine, unless something more radical is opposed to counteract this irregularity.

It is just at this point that the Nash method of direct connection, show in cut of 300-light plant on page 452, comes in to correct what neither the governor nor any arrangement of cylinders in a gas engine is able to accomplish without some other device acting jointly with them. This device is the Nash centrifugal coupling, which is a feature of the direct-connected plants operated by the Nash system. In this system, the engine and dynamo are not rigidly connected, but the dynamo is driven by a special coupling so arranged and adjusted that in spite of any tendency to irregular speed in the engine due to the causes mentioned or to changes in the load, the dynamo speed is kept practically constant within very narrow limits. The result of the whole combination is that a commercially steady light is produced; there is no flickering in the incandescent lights that the eye can detect and the fluctuations of the voltmeter are almost imperceptible under changing loads. Regulation such as described is believed to be unapproached by any other gas engine combination. The device is simple and strictly in accordance with the requirements as will be apparent on inspection of its operation and the quality of light produced.

Wall Switch Rheostats.

The types of switch rheostats illustrated herewith are designed for use in connection with ceiling fan motors having no self-contained attachment for more than one speed, and for ceiling and desk fans running in series on 220 and 550-volt circuits. By the use of one of these switch rheostats three speeds can be given to a single motor or to a group of motors connected in series.

The devices can be placed in any convenient location, and are particularly useful for the control of the speed of motors in restaurants, stores, etc., where access to the motors themselves is inconvenient. These wall switch rheostats are made in seven sizes, all

FIG. 1.

FIG. 2.

giving three speeds. Fig. 1 shows the size made for the Arctic ceiling fan on 110 volts. All other sizes are made in the style shown in Fig. 2. They are manufactured by the Western Electric Company of New York and Chicago.

A Belted Exhaust Fan.

The exhaust fan shown in the accompanying engraving is so designed as to require no skill in installing, having a flat square back, so that it has merely to be bolted up against the exhaust opening, when it is ready to run. It is made for belted service only, the manufacturers believing that direct-connected fans should not be used in many places where the motor would be subjected to undue heat or to dust, steam and acid vapors in the exhaust. The makers claim that this is the only fan made with adjustable self-oiling boxes, which boxes are provided with phosphor-bronze bushings, and require oiling but once a week. The fan has only about half the number of blades ordinarily used, and the makers claim that this, in connection with the angle of the blades, is of advantage, permitting a free ingress and egress of air and thus adding to the fan's efficiency, which is further enhanced by the neatly fitting bearings and accurate balance. The makers of the fan described, known as the "Triumph exhaust fan," are the Specialty Manufacturing Company, of Indianapolis, Ind.

New Iron Foundry at Schenectady, N. Y.

Chief among the recent accessions to the already large group of factory buildings of the General Electric Co. at Schenectady, N. Y., is the new foundry, an opportunity to inspect which was afforded last week. The most interesting fact in connection with it, illustrative of the enormous demand for electrical apparatus, is that although the first metal was poured so recently as January, it is already inadequate, and more foundry space is needed.

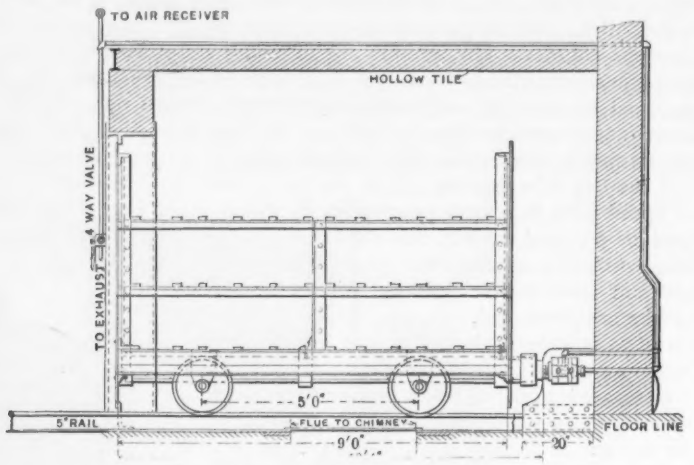
The main building is 140 feet by 503, with a cleaning room wing 120 feet by 103. Additional to these are a couple of large "lean-tos," one 38 feet 6 inches by 243 feet, and the other 11 feet 4 by 152 feet 4. The extreme height is just over 58 feet, and the cubic

GENERAL VIEW OF FOUNDRY—MAIN AISLE.

contents are 3,250,000 feet. For the steel construction, the contractors were the Fulton Bridge Co. The sand shed has a capacity of 6000 tons and the coke shed of 600. The equipment of the main foundry is in every respect up-to-date, comprising three Calliau cupolas of 18, 11 and 7 tons of molten metal capacity per hour; a Root blower of 660,000 cubic feet of air capacity per hour, running at 95 revolutions; Buffalo Forge Co.'s heating fans; a 2220 pounds hydraulic elevator and other essential features. A notable item is the remarkably generous equipment of electric cranes, there being seven now in the building, while there will eventually be six jib cranes. There are now one 40-ton Morgan electric crane and one 10-ton, each of 65-foot span, but the work for these is greatly relieved by the system of handling the flasks, etc., by the jib cranes, and whose intermediate use sets the big vranes free for regular heavy work in the main aisle.

The resort made to electric motors is notable, and would not escape the most fugitive observation. Some of them are large, one of 60-hp being attached to the cupola blowers and one of 50-hp to the rumblers and wheels. Then there are four motors on the 40-ton cranes, 3 on the 10-ton, eight on the 5 and 7-ton cranes, and three on the jib cranes. All told there are 27 motors doing work around this foundry.

The general details of all foundries are necessarily alike, but the new foundry at Schenectady has a number of features that seem to commend themselves to practical foundrymen. The utilization of jib cranes has already been mentioned. Another ingenious device is the method of operating the core ovens. The hand car carrying the cores has a door fastened at each end. By the application of compressed air the cars are run out, and as they leave the oven the rear door automatically closes the orifice, so that neither does hot air escape nor does cool air enter. When the car has been unloaded and charged again, it is run back, at which moment the outer door on the car seals up the oven. It is obvious that by this method uniformity of temperature is admirably maintained,

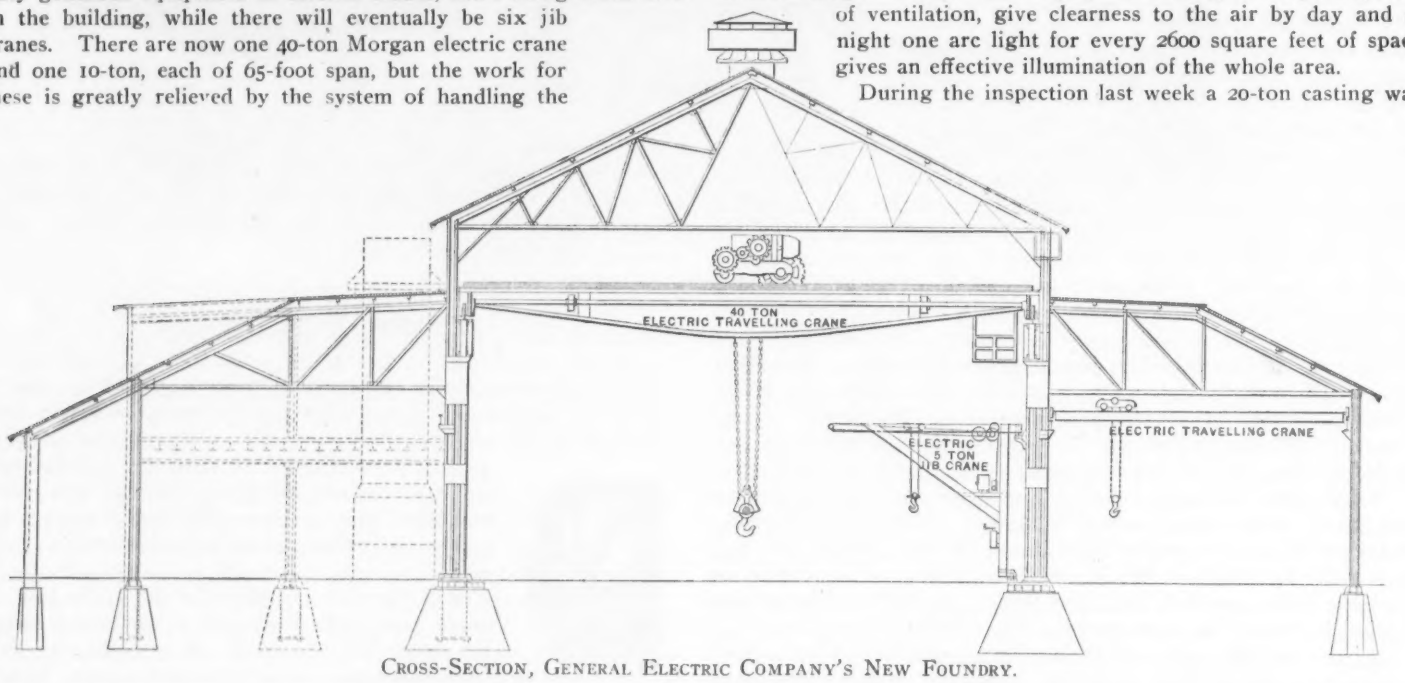


CROSS-SECTION OF CORE OVEN.

with consequent economy and improved results. Just outside the ovens are racks for storing cores.

Everything has been arranged for handy use. No metal has to be carried more than 120 feet from the cupolas, and the locations for flask making, storage of working patterns, for the core making and baking, for superintendence offices, etc., have all been judiciously planned. One is also peculiarly impressed with the lightness and brightness of the place, so different from the murky gloom of the average foundry. The skylights, aided by the superb system of ventilation, give clearness to the air by day and at night one arc light for every 2600 square feet of space gives an effective illumination of the whole area.

During the inspection last week a 20-ton casting was poured of the frame of a large generator, and even bigger work is in immediate contemplation.



CROSS-SECTION, GENERAL ELECTRIC COMPANY'S NEW FOUNDRY.

It would not be proper to close this account of the foundry, without referring to the efforts made to render the employees in it comfortable. Not only is there a lavatory with the latest fittings, but shower baths available to all, offer an invitation that cannot be resisted.

NEWS OF THE WEEK.

Financial Intelligence.

NEW ENGLAND TEL. & TEL. COMPANY has disposed of $500,000 5 per cent. debenture bonds to Adams & Co., of Boston.

PHILADELPHIA.—The Pennsylvania Manufacturing, Light & Power Company has declared a dividend of 50 cents, payable April 15.

CENTRAL UNION TELEPHONE CO.—The 5 per cent. gold bonds offered by Messrs. Poor & Greenough and E. R. Morse & Bro., have been fully taken.

THE BELL TELEPHONE COMPANY, of Philadelphia, capital $2,616,750, without bonds or preferred stock, and paying 2 per cent. quarterly dividends, has been listed at the Stock Exchange in that city.

CONSOLIDATED STREET-CAR COMPANY has been organized this past week, with a capital of $18,000,000. The incorporators are William Brinckerhoff, William P. Chapman, Jr., Albert G. Ridley and Francis D. Pollard, all of New York.

MICHIGAN TELEPHONE.—Directors of the Michigan Telephone Co. meet the latter part of April to consider the dividend question. Persons in position to know say the dividend will probably be at the rate of 1¼ per cent. quarterly and that the stock should sell at par.

CHICAGO SOUTH SIDE.—The directors of the South Side "L" in Chicago have declared a dividend of 1 per cent. upon the capital stock for the four months ending April 30. This puts the stock upon a 3 per cent. dividend basis. The dividend is payable May 1 to stock of record April 20.

BALTIMORE, MD.—The directors of the United Railways and Electric Company, of Baltimore, have authorized the issue of 4 per cent. income bonds to the amount of $14,000,000, to be issued in substitution and exchange for the preferred stock. It is also provided that the holders of all or any of the preferred stock have the right to exchange at par their preferred stock for the income bonds.

BUYING MASSACHUSETTS ROADS.—It is stated from Lawrence, Mass., that a movement is on foot by a New York syndicate, of which J. Pierpont Morgan is said to be the head, to secure control of a number of the street railroads in Massachusetts. It is reported that the syndicate has already purchased a controlling interest in the Lawrence, Lowell & Haverhill road, and also the street railroad in Brockton, and that negotiations are about closed for a purchase in Gloucester, Mass. In the purchase of stock in these roads not only a controlling interest is obtained, but all stockholders receive offers for

SOURCES OF BELL INCOME.—A study of the annual report of the American Bell Telephone Company for 1898 in connection with reports for previous years, as printed in these pages last week, shows most strikingly the transfer of the company's income from a royalty or telephone rental basis to a dividend receipt basis. For instance, the income from rentals last year was $1,610,855, while that from dividends from stocks of sub-companies was $3,239,406. In 1890 dividends received were $1,256,274, while income from rentals was $2,109,574. In other words, nine years ago rentals were almost twice the amount of dividends received; now dividends are twice the amount of rental receipts.

ELECTRIC VEHICLE IN NEW ENGLAND.—The electric vehicle stocks are, as the New York *World* notes, attracting a great deal of attention now, and there are many rumors concerning them floating around in the outside market. It is generally believed that the Widener-Elkins syndicate is in the various companies heavily, and that theory has strengthened them with the public. The Electric Vehicle Company, which is the parent company, has just chartered the New England Electric Vehicle Company, to which it has sold the rights for Boston. The new company will give the other 10 per cent. of its $25,000,000 capital stock and other assets in the shape of royalties. Some leading Bostonians are in the company.

MASSACHUSETTS TRACTION ROAD SOLD.—E. Rollins Morse & Bro., and Tucker, Anthony & Co., brokers, of Boston, have purchased all the assets of the North Shore Traction Company, including the stock of the Lynn & Boston and Beverly & Danvers Street Railway Company, for $258,800. The reason for the sale was that the owners of the North Shore Traction Company, which secured incorporation under New Jersey laws, were discouraged by legislation affecting foreign corporations owning and operating Massachusetts street roads. The capital stock of the Lynn & Boston amounts to $1,266,000, all of which was owned by the North Shore Traction Company. The stock of the North Shore Traction Company amounts to $6,000,000, of which $2,000,000 is preferred and $4,000,000 common stock.

BROOKLYN TRANSIT'S NEW STOCK.—It is stated that Brooklyn Rapid Transit stockholders are to receive the right to subscribe at par to the $3,000,000 new stock—about 7 per cent. of their present holdings. The money raised by the stock subscription is to be used to pay for the Brooklyn and Brighton Beach and other recently acquired properties, and for improvements, including the change of motive power to electricity. President Baldwin, of the Long Island Railroad Company, admitted that closer relations with the Brooklyn Rapid Transit Company will soon be established. It is understood that the Long Island road will agree to let the transit company make connections with and run its cars over certain sections of the Long Island's tracks, including the right to run cars right into Manhattan Beach.

ELECTRIC VEHICLE.—The New York *Times*, discussing changes in Electric Vehicle quotations says: "The recent heavy decline in the stock of the Electric Vehicle Company and of the New York Electric Vehicle Transportation Company has been attributed to a rumor of some trouble between the Electric Vehicle Company and the Electric Storage Battery Company, from which the former company purchases the storage batteries used in its electric cabs and other vehicles. In denial of the rumor it is pointed out that it is not at all likely that the Electric Storage Battery Company would throw aside the very large orders which the Electric Vehicle Company is in a position to give it, and which, it is said, will amount to several million dollars." In comment upon this, it may be sufficient merely to point out that Mr. I. L. Rice is president of both concerns. It is a probability that some one was short of the stock and bearing the market was a good way to get it.

LONG DISTANCE TELEPHONE CAPITAL.—Increase of capital stock from $25,000,000 to $75,000,000 is proposed by the American Telephone & Telegraph Company, of New York City. The company has certified this addition to the Secretary of State in Albany. The certificate had the names of John E. Hudson, C. W. Amory, Henry S. Howe, Melville Egleston and Edward J. Hall as directors of the company. The amount of capital stock actually paid in is $23,500,000. It is explained by a representative of this corporation that the great increase in capitalization had been made simply to keep pace with the growth and expansion of the company. It is believed in some quarters, however, that the move foreshadows an early development of the parent corporation, the American Bell Telephone Company. The report was noted in these columns some time ago that that corporation was about to surrender its charter in Massachusetts and remove its principal offices to this state of New Jersey. The capitalization of the American Bell Telephone Company is in excess of $25,000,000.

THE WEEK IN STOCKS was a short one owing to the Easter holidays, but its liveliness more than compensated for the lessened duration. At the close there were many indications of a revival of bull sentiment, and the half day on Saturday in Wall Street was noteworthy for some remarkable advances. The only stock which in these brisk days lingers behind most unaccountably is Western Union, which closed at 93⅜, or lower than a month ago. It would be interesting to have some one rise and explain this inertia. General Electric on good sales closed the week at 117, and Metropolitan Street Railway at 265½. The sensational rise was in Manhattan, which on Saturday jumped to 126, and even touched 131, on sales of 120,064 shares; the rumor being that a Metropolitan purchase was afoot. Perhaps the bird is bagged already. Brooklyn Rapid Transit closed at 134. On the Boston market, American Bell Telephone made a new record by going to 368, while West End Railway was firm at 94. Copper shares are all strong again there, Calumet and Hecla being 770 bid and Boston and Montana 351. In Philadelphia, Electric Storage Battery stood at 160½, and Union Traction was 40¾; Philadelphia Traction reaching 96¾. Among the miscellaneous stocks in New York, Electric Vehicle, preferred, ex. dividend, was bid at 114, but 130 was asked and the common was bid at 110¼. Electric Boat preferred was quoted at 50 and common at 30. Otis Elevator, preferred, was quoted at 91 and common at 36. Hudson River Telephone was offered at 92.

TRADE CONDITIONS are reported by Bradstreets as follows: "There is a quieter tone in several lines of business this week, independent of the reduction in volume of distributive demand, resulting from continued unfavorable weather conditions in a large section of country. The strength of quoted values, however, fails to show that any material slackening of underlying movements has as yet become apparent in leading lines. Less is doing naturally in leading eastern textile markets on the current season's account, but an encouraging element is found in the readiness of buyers to place orders for fall delivery. While leading western markets note that the edge has been taken off demand and that bad roads and weather combined have retarded retail distribution, and hence affected collections in some sections, results of the first quarter's trade with wholesalers have been so good that their sanguine cheerfulness as to the outlook is especially notable. Past reports of prosperous trade conditions find confirmation in the smallest number of failures for the first quarter reported for seventeen years past, while liabilities are lighter than for twelve years preceding. The percentage of assets to liabilities, too, is as low as that reported in the most prosperous years. Decreases in number are a feature in all parts of the country, with the sole exception of New England, and even here the liabilities are lighter than a year ago, and there is nothing indicating any notable weakness in special industries as in some past years. The total number of failures for the first quarter of 1899 was 28,779, 21 per cent. smaller than last year, 31 per cent. less than in 1897, and 13 per cent. smaller than in 1892, while liabilities aggregate $31,221,658, 13 per cent. less than in 1898, 50 per cent. less than in 1896, and 20 per cent. smaller than in 1893."

CHICAGO EDISON.—The question of increasing the capital stock will be submitted to vote at the forthcoming annual meeting, and part of the new stock, which will undoubtedly be authorized, will be issued in the fall, going to the old holders at par in proportion to their holdings. The amount of new stock thus to be put out cannot be exactly stated at this time, but it will not be less than 10 per cent. of $4,975,900, the present outstanding capital. The proceeds of the stock issue will be used to pay for extensions and betterments. The company is authorized under its mortgage to issue nearly $2,000,000 of additional bonds at any time to cover cost of extensions and permanent improvements, and the fact that the directors have decided to issue new stock rather than additional bonds is an indication of what they think of the prospects in regard to earnings, for there is no intention of disturbing the present 8 per cent. dividend rate. This increase of stock, however, does not necessarily establish a precedent as to the company's future method of obtaining increased capitalization. That is, future increases of capitalization may be in form of bonds rather than of stock. The company will probably spend $600,000 this year for extensions and betterments, and without doubt there will be large like expenditures every succeeding year, because the business is constantly growing. Gross earnings have doubled in seven years. Such growth of business demands continual capital expenditures, which will be met by stock issues or bond issues, as may be deemed expedient from time to time. The last increase of capital stock was authorized in February, 1894. The fiscal year just ended will show a large increase in output of current. It is the well known policy of the management to reduce prices to consumers year after year rather than try to earn any large surplus over the 8 per cent. dividend requirement. President Insull states that there have been no negotiations whatever looking to the acquisition of this company by the People's Gas Light & Coke Company, or to a merger of the interests, as alleged in some New York despatches. The relations be-

tween the two companies are perfectly friendly, and they are not in competition. Some experts in this line think that the ownership of the gas and electric lighting businesses by the same interest is advantageous, and the two lines are practically consolidated in a number of cities. But nothing has been attempted here in that line as yet.

BOSTON EDISON.—The directors of the Edison Electric Illuminating Company of Boston, offer to stockholders of record April 6, with permission of the board of gas and electric light commission and under vote passed by stockholders Dec. 10, 1896, 1702 shares of the capital stock of the company at $120 per share, at the rate of one new share for every 22 old shares now held. A "right" attaches to each share of old stock to subscribe for 1-22d of a share of new stock, but subscriptions for full shares only will be accepted. This distribution leaves in treasury of company 58 shares, which, with any of the above issue not subscribed for, will be sold by public auction at such time as the directors may order.

Special Correspondence.

NEW YORK NOTES.

PERMANENT RECEIVERS APPOINTED.—Judge Gildersleeve, of the Supreme Court, has appointed Messrs. A. K. Warren and Francis Higgins permanent receivers of the American Electrical & Maintenance Company, for which temporary receivers were appointed last October.

SPECIAL TROLLEY CARS TO CONEY ISLAND.—The Brooklyn Rapid Transit Company will probably run special cars from the Manhattan end of the bridge and from the foot of Broadway, Williamsburg, to Coney Island during the summer. It is proposed to charge a 10-cent fare on these cars. It is not the intention, however, to reduce the number of regular cars at the 5-cent rate.

TRANSIT AGREEMENT BETWEEN THE BROOKLYN RAPID TRANSIT AND THE LONG ISLAND RAILWAYS.—On April 1 agreements were executed between the Brooklyn Rapid Transit Company and the Long Island Railroad Company, by the terms of which each company undertakes to foster and encourage the business of the other in its own territory by joint operation and otherwise. The effect of this will necessarily be to improve transportation facilities and promote the public convenience as well as to increase the receipts of both systems. The agreements provide for the operation by the companies of each system over railroads of the other, so as to form a number of new through routes without change of cars from the business centres of New York and Brooklyn to the suburban districts and summer resorts on Long Island. One of the Brooklyn Rapid Transit companies becomes the lessee of the railroads of the Prospect Park & Coney Island Railroad Company, of the Prospect Park & South Brooklyn Railroad Company and of the New York & Coney Island Railroad Company, thus giving several short and direct through routes from the Brooklyn Bridge to Coney Island and Sea Gate, as well as to Bensonhurst and the intervening territory. The Rapid Transit companies also acquire the right to operate over the railroad of the New York, Brooklyn & Manhattan Beach Railroad Company to Manhattan Beach, giving direct connections between Manhattan Beach and all points reached by the surface and elevated railroads. A new express passenger route is also opened between Jamaica and the Brooklyn Bridge via the Long Island road to Flatbush Avenue, and thence over the Brooklyn Union Elevated road. This route will be operated by the Long Island Railroad Company and will bring the Jamaica territory within 35 minutes of the City Hall in Manhattan. Cars of both systems will also be operated between the Broadway ferries and Rockaway Beach, via the Brooklyn Union Elevated. These agreements enable the Long Island Railroad Company to bring all parts of Brooklyn and Manhattan into close connection with its lines, and, following the acquisition by the Brooklyn Rapid Transit Company of the Brooklyn Union Elevated system and of the Brighton Beach Railroad, enable the Rapid Transit Company to satisfactorily solve the problem of local transportation within the boroughs of Brooklyn and Queens and between the boroughs of Brooklyn and Manhattan.

NEW YORK ELECTRICAL SOCIETY held a most successful meeting on Wednesday evening, March 29, at the house of the American Society of Civil Engineers, when Professor Elihu Thomson lectured on "Electricity at High Pressures; or, High Voltage Phenomena." Over 400 members and friends were in attendance, and Prof. Thomson had the stage filled with apparatus in charge of an assistant. The lecture was, as usual, delivered with beautiful simplicity and clearness, many familiar facts being gone over with delightful originality, and then new ideas and apparatus were brought to notice, including a remarkable improvement in the accumulation features of the well known Plante rheostatic machine, coupled with a machine which would not only serve as a high voltage generator, but would run on almost any kind of application of mechanical power or form of current from outside. The Society proposes to publish the lecture in pamphlet form. During the evening the following members were elected: Theodore Boran and F. C. Bates, General Electric Company, 44 Broad Street, New York City; R. H. Proctor, 39 Cortlandt Street, New York City; G. H. Seward, Crocker-Wheeler Elec. Company, Ampere, N. J.; Philip R. Backus, Edward L. Reynolds and Harcourt Lee, Elec. Storage Battery Company, 20 Broad Street, New York City; R. R. Reed and S. L. Nicholson, Westinghouse Electric Company, 120 Broadway, New York City; Henry O. Pond, Westinghouse, Church, Kerr & Company, 26 Cortlandt Street, New York City; I. Walter Ullman, Blake & Williams, 362 West Broadway, New York City; Jefferson Wetzler, 120 Liberty Street, New York City; E. M. Beane, Edison Mfg. Company, Broadway and Twenty-sixth Street, New York City; William Yeager, Frederic G. Sykes, C. S. McCalla and Cabot Stevens, Edison Elec. Illum. Co., 360 Pearl Street, Brooklyn, N. Y.; Randall D. Warden, 601 Newark Street, Hoboken, N. J.; Hawthorne Hill, Engineering Magazine, 120 Liberty Street, New York City; L. J. McDowell, The Maintenance Company, 220 Broadway, New York City; Ernest Woltman, 123 Liberty Street, New York City; S. Edward Eaton, 393 Pearl Street, New York City; A. L. Holt, New York Board of Fire Underwriters, 32 Nassau Street, New York City; William Maver, Jr., 120 Liberty Street, New York City; Frederic Woodhull, American Elec. and Maintenance Company, Desbrosses and Greenwich Streets, New York City; Dr. Samuel Sheldon, Polytechnic Institute, Brooklyn, N. Y.; Peter Cooper Hewitt, 11 Lexington Avenue, New York City; A. Livingston Bogart, 123 Liberty Street, New York City.

PREPARING FOR THE ELECTRICAL EXHIBITION.—A great deal of preliminary work is now being done for the Exhibition, which opens at Madison Square Garden on May 8, and the whole of the main floor has already been allotted. Practically 20,000 feet has already been pre-empted. Several novel features are in contemplation, and Mr. Luther Stieringer, as consulting engineer, is said to have devised some beautiful lighting and other effects that will more than sustain his reputation. The following is a partial list of intending exhibitors up to the end of March, since when several additional contracts for space have been closed: American Engine Company, Bound Brook, N. J.; American Electric Novelty & Manufacturing Company, 255 Centre Street, New York; American Vitrified Conduit Company, 39 Cortlandt Street, New York; American Electric Vehicle Company, 1545 Michigan Avenue, Chicago; American Miniature & Decorative Lamp Company, 255 Centre Street, New York; American Circular Loom Company, Boston, Mass.; Adams-Bagnall Electric Company, Cleveland, Ohio; American Mutoscope Company, 837 Broadway, New York; American Pulley Co., Philadelphia, Pa.; Ball & Wood Co., 120 Liberty Street, New York; Buffalo Forge Company, Buffalo, N. Y.; Boston Electro-Duct Company, Boston, Mass.; Bullock Electric Company, 220 Broadway, N. Y.; Bossert Electric Construction Company, Utica, N. Y.; Bryan Marsh Company, 136 Liberty Street, N. Y.; Cling-Surface Manufacturing Company, 146 Virginia Street, Buffalo; Cincinnati Shaper Company, Cincinnati, Ohio; Crocker-Wheeler Electric Company, 39 Cortlandt Street, New York; Camp Co., H. B., Aultman, Ohio; Colliery Engr. Company, Scranton, Pa.; Corey, R. B., 26 Cortlandt Street, New York; Columbia Incandescent Lamp Company, St. Louis, Mo.; Cutter Electrical & Manufacturing Company, 1112 Sansom Street, Philadelphia, Pa.; Dietz, Schumaker & Boye, Cincinnati, Ohio; Dixon, Jos., Crucible Co., Jersey City, N. J.; Dale Col., The, Thames and Greenwich Streets, New York; Emerson Electric Manufacturing Company, St. Louis, Mo.; Estey & Saxe, 97 Fifth Avenue, New York; Electrical Appliance Company, Jersey City, N. J.; Electrical Engineer Inst. of Corres. Instr., 120 Liberty Street, New York; Forbes, W. D., & Co., Hoboken, N. J.; Fayerweather & Ladew, 159 East Houston Street, New York; Frink, I. P., 551 Pearl Street, New York; Fisher Foundry & Machine Company; Granger, Francis, 26 Cortlandt Street, New York; Griffing, A. A., Iron Company, 66 Centre Street, New York; Gold Car Heating Company, Frankfort and Cliff Streets, New York; General Incandescent Arc Light Company, Thirty-third Street and First Avenue, New York; International Correspondence Schools, 14 East Seventeenth Street, New York; Indiana Bicycle Company, Indianapolis, Ind.; India Rubber & Gutta-Percha Insulation Company, Glenwood, N. Y.; Kaufman & Alexandre, 1153 Broadway, New York; Lamble, H. V., Rockaway, L. I.; Libbey Glass Company, Toledo, Ohio; Machado & Roller, 203 Broadway, New York; McCay Engineering Company, 106 East German Street, Baltimore; National Gramophone Company, 874 Broadway, New York; National Meter Company, 118 Chambers Street, New York; New York Electric Equipment Company, Thirty-third Street and First Avenue, New York; Northern Engineering Company, 39 Cortlandt Street, New York; Niles Tool Works, Niles, Ohio; Northern Electrical Company, Madison, Wis.; New York Telephone Company, 18 Cortlandt Street, New York; Orient Electrical Company, Youngstown, Ohio; Prindle Pump Company, 120 Liberty Street, New York; Paragon Fan Motor Company, Brooklyn, N. Y.; Pope Manufacturing Company, Motor Carriage Department, Hartford, Conn.; Pittsburg Reduction Company, Pittsburg, Pa.; Rockwood Manufacturing Company, Indianapolis, Ind.; Roebling, John A., Sons Company, 117 Liberty Street, New York; Risley-Bird Manufacturing Company, 94 Fifth Avenue, New York; Riker Electric Motor Company, 45 York Street, Brooklyn, N. Y.; Standard Steam Specialty Company, 83 Centre Street, New York; Stirling Company, The, Chicago, Ill.; Safety Insulated Wire & Cable Company, 229 West Twenty-eighth Street, New York; Union Boiler Tube Company; Warren-Medbury Company, Sandy Hill, N. Y.; Williams, J. P., 39 Cortlandt Street, New York; White, S. S., Dental Manufacturing Company, Chestnut and Twelfth Streets, Philadelphia, Pa.; Wagner Electric Manufacturing Company, St. Louis, Mo.; Willard & Frick, Rochester, N. Y.

NEW ENGLAND NOTES.

STATE TELEPHONE SUPERVISION in Massachusetts has been voted down in the Legislative Committee on Mercantile Affairs.

BELL DIRECTORS.—The following American Bell officers have been elected: Clerk, Charles Eustis Hubbard; treasurer, William R. Driver; directors, Charles W. Amory, Thomas B. Bailey, Francis Blake, George L. Bradley, Alexander Cochrane, T. Jefferson Coolidge, Jr., J. Malcolm Forbes, Henry S. Howe, Charles Eustis Hubbard, John E. Hudson, Charles E. Perkins, Thos. Sanders and Moses Williams.

UNITED STATES AUTOMOBILE COMPANY, of Pawtucket, R. I., has recently been incorporated with a capital of $250,000 for the purpose of manufacturing electric motor carriages and appliances. The incorporators are Frank Mossberg, president, of Providence; Julian A. Chase, of Pawtucket, treasurer. The company's headquarters are at 623 Atwell's Avenue, Providence. Mr. Mossberg is well known in the machinery and electrical fields.

THE SIXTH ANNUAL REPORT of the Board of Electrical Commissioners of South Norwalk, Conn., has just been issued. It will prove of special interest to towns considering the question of establishing their own particular lighting system. South Norwalk is generally regarded as a criterion on the subject of municipal ownership under good auspices, and its carefully prepared report justifies this opinion. It gives in detail the complete cost of the installation, together with the detailed statement of the running expenses. So many indefinite and vague statements are made in regard to the cost of running municipal plants that the clear, detailed and reliable report of South Norwalk will be particularly valuable. A good word is said for the Watertown engines and

boilers and the Siemens & Halske electrical apparatus which form important features in the new plant.

BUFFALO NOTES.

CONSOLIDATED BUFFALO STREET RAILWAYS.—The transfer of the street railway properties of Buffalo and vicinity, as previously noted in this column, has been completed. At a meeting of the Buffalo Railway Company, held in New York March 25, the following officers were elected: President, W. Caryl Ely; vice-president, Daniel S. Lamont; general manager, Burt Van Horn; secretary and treasurer, Richard F. Rankine. The Board of Directors consists of Chas. H. Coster, of J. P. Morgan & Co.; T. Dewitt Cuyler, D. S. Lamont, Francis Lynde Stetson, W. B. Rankine, W. Caryl Ely, Burt Van Horn, Henry M. Watson, C. C. Cuyler, R. L. Fryer, J. N. Scatchard, George Urban, Jr., Daniel O'Day. The Executive Committee consists of Messrs. Ely, Lamont, Stetson, Coster, Rankine and Van Horn.

PAN AMERICAN EXPOSITION.—It has been decided to increase the capital stock to $2,500,000. Permanent committees of the directors have been appointed for Finance, State and Foreign Relations, Concessions, Publicity, Laws and Insurance, etc. Mr. Edwin Fleming has been appointed secretary of the Exposition. Col. John B. Weber is Commissioner General, to deal with foreign governments; Newcomb Carlton, M. E., has been appointed to visit the sites of all the greater expositions of the United States and obtain information concerning them for the directors. An Executive Committee has been formed to have general charge of all Exposition work. Mr. John N. Schatchard is chairman. At present this committee is considering the question of a site, and is assisted by an advisory committee of five members of the Engineers' Society of Western New York, and five members of the local chapter of the American Institute of Architects. It seems probable that the Exposition will be located in Delaware Park and adjacent lands, or else on the shore of the Niagara River a short distance north of the city limits.

INDIANA NOTES.

A FRANCHISE is being sought by Tipton and Kokomo capitalists through Tipton, Howard and Marion Counties to the State Fair grounds. The State Board of Agriculture is aiding this enterprise.

ELECTRIC TRACTION ON THE PENNSYLVANIA RAILROAD.—The Pennsylvania Railroad Company has practically settled on electricity as the motive power for its suburban trains between Jeffersonville and Louisville.

THE NEW TELEPHONE COMPANY, of Indianapolis, is directing its efforts toward completing its aerial cable work, and until it is ready the date for beginning service cannot be definitely determined. For this reason the company has announced to its subscribers that it will give them service absolutely free up to July 1, 1899. It is thought service can begin about the middle of April.

AN ELECTRIC ROAD TO WYANDOTTE CAVE.—W. J. Rothrock, principal owner of the famous Wyandotte cave in Crawford County, Ind., has about completed arrangements with eastern capitalists to build and operate an electric line from a point near New Albany, Ind., to the cave. The country is sufficiently picturesque and the cave such a marvel of nature as to render the line very popular.

TELEPHONE ORDINANCE VETO NOT SUSTAINED.—Mayor Elmore, of Crawfordsville, Ind., vetoed the action of the council last week, granting the Bell Telephone Company the right to erect poles in the streets and alleys. The council refused to sustain the veto. The mayor claims the company's franchise has been forfeited. The company is putting poles up all over the town. Litigation is threatened.

THE AMERICAN TELEPHONE COMPANY, of Anderson, Ind., has filed articles of incorporation, capital stock $50,000, with George W. Beers, of Fort Wayne; J. J. Netterville and R. H. Cokefair, of Anderson, as directors. The company's plant will be used as a transfer and switching point for the long-distance lines. It will connect with the National Long-Distance Company, which now connects with all of the independent telephone companies and exchanges in Northern Indiana, Northwestern Ohio and Michigan.

CHICAGO NOTES.

PERSONAL.—Mr. G. G. Luthy, manager of the Royal Electric Company, Peoria, Ill., was in Chicago for a few days last week.

THE W. R. GARTON COMPANY is now located at 315 Dearborn Street, Chicago. Mr. W. R. Garton is president and treasurer and is also prominently connected with the Garton-Daniels Electric Company, of Keokuk, Ia.

MR. FRANCIS RAYMOND has resigned his position with the C. E. Gregory Company, Chicago, to open an office for the Martin J. Insull Company in St. Louis. He will handle, in the South, the General Incandescent Arc Light Company's enclosed arc lamps and switches, Wright Discount Meters, "G. L." incandescent lamps and other specialties.

WISCONSIN NOTES.

MUNICIPAL PLANT IN BOSCOBEL.—The city of Boscobel has let a contract for a municipal electric lighting plant, which is being installed by Kellyn & Smith, of Milwaukee.

INCREASING CAPITAL STOCK.—The Citizens' Traction Company, of Oshkosh, has filed an amendment to its articles of incorporation, increasing its capital stock from $250,000 to $500,000, for the purpose of building the Neenah interurban line.

POWER TRANSMISSION IN WISCONSIN.—At Durand, Wis., a stock company, with a capital of $25,000, is being formed by Durand and Eau Galle business men to utilize the water power at Eau Galle, six miles distant. The present plan is to build a modern flouring mill and to transmit power by electricity to Durand.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY of Madison has opened a branch office in Milwaukee, at room 600 Pabst building. Mr. A. W. Paine, manager of this office, states that this step was necessary in order to be close to customers and to better attend the numerous inquiries coming from this territory.

THE MILWAUKEE ELECTRIC COMPANY has been incorporated, with a capital stock of $40,000, and will open a plant on the south side in the near future. The stockholders are the same as were in the Gibbs Electric Company, which was some time ago bought out by the Westinghouse Electric & Manufacturing Company. The officers of the company are as follows: President, William P. Harper; vice-president, Walter Cary; treasurer, John A. Whaling; secretary and engineer, Harry W. Morris. The company will manufacture dynamos, motors and other electric appliances. The directors are figuring on several sites on the south side, but have not yet decided on the exact location of the plant.

ST. LOUIS NOTES.

NEW CARS FOR THE NORTHERN CENTRAL.—President C. H. Spencer says his company will make immediate improvements in the Northern Central line, which will be shortly supplied with new cars.

ALLOWANCE FOR A RECEIVER'S SERVICES.—Judge Wood of the Circuit Court made an order last week allowing Charles Green $3425 for his services as receiver of the People's Railway, and requiring him to turn over to F. B. Brownell, who succeeded him as receiver $9446.56, which belongs to the road.

THE PEOPLE'S RAILWAY REORGANIZATION COMMITTEE has made an offer on the same basis as that made by Brown Brothers & Co. of New York. Their bid was $1,125,000. The new syndicate is composed of St. Louisians. They are willing to pay $50,000 down, and the remainder in two days. The proposition stands good.

ST. LOUIS CARS FOR THE BROOKLYN HEIGHTS ROAD.—The Brooklyn Heights Railroad Company of Brooklyn Borough, New York City, has contracted with the Laclede Car Company, the American Car Company, and the St. Louis Car Company, to build 200 cars. These vehicles will be fitted with modern appliances and will cost about $1400 each.

ELECTRIC RAILWAY FRANCHISE.—In the County Court at Clayton a franchise was asked for an electric car line between Jefferson Barracks and the St. Charles Rock Road, by the Electric Connecting Company. This company owns and operates the Carondelet and Jefferson Barracks line, and it is with this that the proposed line is to connect. The petition was taken under advisement.

TEXAS AND MEXICO NOTES.

THE RECEIVERSHIP of the Galveston, Texas, street railway has been ordered closed by Judge Bryant. The road has been ordered to be sold on Sept. 5 for not less than $500,000.

NEW ELECTRIC LIGHT COMPANY IN CITY OF MEXICO.—Compania Mexicana, the new electric light company of the City of Mexico, began furnishing that city with lights on Saturday, March 25.

SALE OF AN ELECTRIC LIGHT PLANT.—The electric light plant of the Citizens' Electric Light Company at Palestine, Texas., has just been sold to Dr. John M. Colley and John W. Wright, of that place. The new owners propose to make improvements in the plant.

THE DALLAS STREET RAILWAY SYSTEM PURCHASED.—The deal for the purchase of the street railway system of Dallas, Texas, by a syndicate of Des Moines, Ia., capitalists has been consummated. The details of the transaction are not yet made public however.

NEW TELEPHONE ENTERPRISE.—Mr. W. B. Teague, of Knox, Tex., has obtained the right of way to construct a telephone line in the town of McKinney. It is his intention to extend the line from McKinney to Leonard, Texas, via Melissa, Stony Point, Van Alstyne, Blue Ridge and Knox.

STREET PAVING BY STREET RAILWAY COMPANIES.—Suit has been filed against the Dallas Consolidated Electric Street Railway Company, Dallas, Texas, to compel it to fulfil its obligation to the city in the matter of street paving. The suit was instituted at the instigation of the city council.

A NEW POWER PLANT IN GUADALAJARA.—Thomas G. Resigue, representing a syndicate of New York City capitalists, is in Guadalajara, Mexico, with a view of perfecting arrangements for the establishment of a large electric power plant in that city. The same syndicate is reported to be negotiating for the purchase of the street railway system of that city.

TELEPHONE TAXES.—The Southwestern Telegraph & Telephone Company has instituted suit against the county collector and the members of the commissioners' court of Bexar County, Texas, for an injunction restraining the collector from levying on its property to collect a franchise tax and to restrain the commissioners' court from assessing the franchise of the company. The franchise of the company in Bexar County was assessed at $20,000.

AMERICANS AFTER MEXICAN STREET RAILWAY CONCESSIONS. Mr. T. L. Merritt, of Philadelphia, Pa., representing a syndicate of capitalists of that city, is seeking to obtain a concession from the government of the state of Tamaulipas, Mexico, for the construction of an electric street railway system in Victoria, the capital of that state. If the concession is granted it is proposed to build the line from the station of the Monterey & Mexican Gulf Railway to the city and through the principal streets thereof. The road will be used to haul both freight and passengers. The same syndicate is figuring on constructing electric lines in several of the other smaller cities of Mexico.

PACIFIC COAST NOTES.

A TELEPHONE line will be built from Everett, Wash., to Arlington.

PERSONAL.—President J. Potter, of the Jandus Arc Lamp Co., Cleveland, Ohio, recently visited San Francisco on a pleasure trip.

THE CAPITAL TELEPHONE COMPANY, Sacramento, Cal., recently elected directors. Frederick Cox is president; M. J. Dillman, vice-president and general manager; W. E. Garber, treasurer, and M. R. Beard, secretary.

THE SAN FRANCISCO & SAN MATEO ELECTRIC RAILWAY COMPANY is laying a double track from Thirtieth and Guerrero Streets to Holy Cross Cemetery. The Eighteenth Street western branch, leading to Golden Gate Park, is now in successful operation.

THE SNOQUALMIE FALLS POWER COMPANY has appointed Mr. James C. Drake manager of the section of its lines that will supply Tacoma, Wash., with electricity. Mr. Drake was very successful in the capacity of receiver of the Tacoma Gas & Electric Company.

CANADIAN NOTES.

THE MARITIME ELECTRICAL ASSOCIATION, of Canada, will hold a convention about the 18th of April in Halifax, Nova Scotia.

AN ELECTRIC CAB COMPANY has been formed in Toronto, Ont., by Geo. A. Cox, A. E. Ames and others, which will build horseless carriages in the shops of the Canadian General Electric Company, at Peterboro, under the Fischer patents.

DEVELOPING A WATER POWER PLANT NEAR OTTAWA.—The Ottawa Metropolitan Electric Company has commenced construction work on its canal and power house near Britannia, five miles from Ottawa. The operations will be continued over a period of six months.

MESSRS. LAWRY, SONS & CO., of Hamilton, Ont., pork packers, are changing from steam to electric power, and have placed an order with the Royal Electric Company for a 30-hp two-phase "S. K. C." induction motor. They are also lighting their factory throughout by electricity.

THE NIAGARA FALLS, ST. CATHERINES AND TORONTO RAILWAY COMPANY is applying to the Ontario Legislature for incorporation, with power to take over the St. Catherines & Niagara Central Railway Company, and to extend to Port Dalhousie and Hamilton, Ont.; also to acquire, generate, use and sell electric power, and operate steamboats, etc.

ELECTRIC LIGHTING IN NOVA SCOTIA.—A bill to incorporate the Nova Scotia Electrical Light & Heat Company has passed the Legislature of that province. The company proposes to light by electricity the whole of the Annapolis Valley from a power station to be situated on the Gaspereau River. The estimated expenditure is placed at $400,000. One of the incorporators is the Hon. F. W. Borden, Minister of Militia for Canada.

ELECTRIC RAILWAY BETWEEN QUEBEC AND ST. ANNE DE BEAUPRE.—Messrs. Ahearn & Soper, of Ottawa, have received the contract for the equipment of the electric railway between Quebec and St. Anne de Beaupre, via Montmorency Falls and Beauport, a distance of 28 miles. The contract includes the power house, generators at Montmorency Falls, rotary transformers at St. Anne's and all the cars and electrical apparatus in connection therewith. The cars will be 55 feet in length and will be manufactured in Ottawa. The electrical apparatus is to be manufactured by the Westinghouse Company. The line will be the longest electrical railway in the Dominion.

RAILWAY CONSOLIDATION IN HAMILTON.—An extensive project is on foot to amalgamate all the electric railways doing business in Hamilton, Ont., and it is said that New York capitalists are at the back of the scheme. Mr. John Patterson, secretary-treasurer of the Cataract Power Company, is the promoter of the deal, and has already secured options on the majority of stock in the Hamilton Street Railway and the Hamilton Radial Electric Railway. The Hamilton, Grimsby and Beamsville Railway, Hamilton and Dundas Railway, and the proposed electric road to Guelph, are also to be gathered in, and the Cataract Power Company will furnish the power for all the roads, thus doing away with individual power houses, and saving a big expenditure.

TRANSMISSION PLANT IN ONTARIO.—A syndicate of Toronto capitalists, headed by Mr. J. A. Culverwell, electrical and mechanical financial broker, is reported to have purchased the Burleigh Falls water power, near Peterboro, Ont. The purpose is to develop the power and transmit it to Peterboro and Lindsay, 20 and 30 miles distant, respectively. There is a head of 25 feet, and an estimated power of between 300 and 500-hp. The dam and power house will be located at Perry's Creek, at a point where the channel is so narrow that a concrete dam for the purpose can be built at a cost of about $5000. At Lindsay the town lighting contract has been secured for ten years, and the revenue from power and light amounting to some $15,000 per annum. The company will be capitalized at $200,000.

General News.

THE TELEGRAPH AND TELEPHONE.

SIOUX FALLS, S. D.—Dr. Miller has been granted a fifteen-year telephone franchise.

LESLIE, MICH.—A local telephone company has been organized here to build a line to Pleasant Lake.

JEFFERSON, IOWA.—A 100-mile extension will be made of the lines of the Jefferson Telephone Company.

OTTUMWA, IOWA.—The Ottumwa Long Distance Telephone Company has obtained a franchise from this city.

TIFFIN, OHIO.—The Home Telephone Company is making preparations to extend its lines throughout the county.

CLYDE, N. Y.—A 30-mile extension of the Wayne Telephone & Telegraph Company's lines will be built during the summer.

ST. LOUIS, MO.—The Missouri & Kansas Telephone Company is about to extend its lines from Pierce City to Sarocoxis, Mo.

PLAIN CITY, OHIO.—The Home Telephone Company, of this place, is making arrangements to build a 30-mile extension.

WEBSTER CITY, IOWA.—A 150-mile extension of the lines of the E. H. Martin Telephone Company, of this place, is to be built.

BRIGHTON, IOWA.—An election will be held here soon to vote on the question of granting franchises to two telephone companies.

AXTELL, MO.—The Axtell Telephone Company has been incorporated, with a capital of $2500, by George Delaney and thirteen others.

DULUTH, MINN.—The Mesaba Telephone Company will extend its lines to McKinley and Bievabik, Minn., and ultimately to Duluth.

PEORIA, ILL.—The Automatic Telephone Company has accepted the franchise offered it by the City Council, with all its restrictions.

VALLEY JUNCTION, IOWA.—The City Council has granted a 21-year franchise to the Mutual Telephone Company, of Perry, Iowa.

MASON, OHIO.—The Warren County Telephone Company will soon build a ten-mile extension. Mr. J. W. Van Dyke is superintendent.

NEW LONDON, OHIO.—The North Ohio Telephone Company will shortly build an exchange at West Liberty. Mr. D. A. Yoder is president.

INDIANA, PA.—President M. C. Watson, of the Indiana Telephone Company, announces that a 20-mile extension will be built by that concern.

HANNIBAL, MO.—The Missouri & Kansas Telephone Company is constructing a line across Missouri east and west from Hannibal to St. Joseph.

MERIDEN, CONN.—The Citizens' Telephone Company has been granted a franchise in this city. Two other telephone companies are seeking like privileges here.

CENTRAL CITY, IOWA.—The Bishop Telephone Company is at present operating 300 miles of lines and will soon add 50 miles more. Mr. P. G. Henderson is president.

WASHINGTON, IOWA.—Mr. L. D. Robinson, president of the Washington Telephone Company, announces that an extension of 75 miles will be made of the company's lines.

CHARLES CITY, IOWA.—The Northwestern Telephone & Construction Company is planning an extension of 20 miles of toll line. Mr. H. J. Fitzgerald is the president.

TICONDEROGA, N. Y.—The Ticonderoga Telephone Company will soon extend its line to Hague and Sabbath Day Point on Lake George. Mr. W. W. D. Jeffers is the president.

TABLE ROCK, NEB.—The Table Rock Telephone Company has been incorporated by W. C. Fellows, C. R. Judkins and C. J. Wood, all of Table Rock. The capital stock is $3000.

CAMBRIDGE, OHIO.—Messrs. Hoyle and Scott contemplate the extension of their telephone line in the near future to points in Guernsey County. The firm now has 220 subscribers.

LYONS, N. Y.—The Lyons Telephone Company has been incorporated here and will be under the same management that controls the Wayne exchange. Mr. A. B. Bishop is president.

LINESVILLE, PA.—The Linesville Telephone Company has been organized, with a capital stock of $6000. The incorporators are S. H. Wilson, J. A. Martin and others, all of Linesville.

BRITT, IOWA.—The Western Electric Telephone System will extend its lines 300 miles during the year. The company is now operating 1000 miles of wire. Mr. J. F. Cass is president.

ALINA, MICH.—The Union Telephone Company has been incorporated in this place, with a capital stock of $25,000, by George Aldrich, of St. Louis, Mich.; G. S. Ward, of Alina, and others.

NILES, MICH.—The City Council has granted a franchise to the Central Telephone Company, of Kalamazoo, to establish an exchange here. The rates will be $12 for residences and $18 for business houses.

COLUMBUS, O.—The private telephone line between Columbus and Sugar Grove, Ohio, operated by the Columbus Natural Gas Company, is to be reconstructed. Forty-seven miles of new wire will be strung.

WILKESBARRE, PA.—The People's Telephone Company recently placed an order for $60,000 in electrical supplies. The line is expected to be in operation by July 1. The number of subscribers is nearly 900.

EDGERTON, WIS.—The Prairie Queen Telephone Company, of this place, has been organized. All of the incorporators are Scandinavians and the exchange will be for the use of that element of the population.

MAUCH CHUNK, PA.—The Pennsylvania Telephone Company has reduced its rates for telephones to $24 a year for long-distance residence telephones and $25 a year for office instruments on the message basis.

JANESVILLE, WIS.—The Wisconsin Telephone Company has announced a cut to $1 a month for telephones in the residence section and the cut will in all probability be met by the Bower City Company, a home enterprise.

PHILLIPSBURG, N. J.—The City Council has refused a franchise to the New Jersey & Pennsylvania Telephone Company for the reason that the ordinance did not guarantee connection with points up the Lehigh Valley or towns in Warren County.

KANSAS CITY, MO.—The stockholders of the Tri-State Telephone Company connecting Kansas City, Mo., and Morganville, Kan., are organizinz to take the affairs of the company out of the receiver's hands and have subscribed $200,000 for improvements.

GRAND RAPIDS, MICH.—Henceforth any resident of Grand Rapids may have a 'phone for $6 a year from the Citizens' Telephone Company. The subscriber can call up any place connected with the exchange, but no one can call up the subscriber.

SPRINGFIELD, MASS.—R. A. Knight, counsel for the Massachusetts Telephone Company, has asked for a franchise in Springfield. The company promises to furnish connection with New York and the West 50 per cent. cheaper than the present rates.

CANISTEO, N. Y.—Mr. W. A. Feenaughty, of Addison, has been elected president of the Canisteo Telephone Company. The company's line will run

from Hegesville to Cameron Mills and Rathbone, thence to Addison, connecting there with the lines of other companies.

MINGO JUNCTION, OHIO.—Judge Thomas, of the United States Telephone Company, has made an agreement with the Phœnix Telephone Company to establish long-distance service between the Phœnix and other independent companies throughout this section of the State.

DOYLESTOWN, PA.—The Keystone Telegraph & Telephone Company and the Newtown & Trenton Telephone Company have arranged to connect each other's lines at Doylestown, in which direction they are now being built. This will give through connection from Pottstown to Trenton, including many places between these termini.

DECATUR, ILL.—The property of the Citizens' Mutual Telephone Company was sold at auction a few days ago by the trustee, Mr. J. M. Dodd, who represented the bondholders. The property was purchased by Mr. H. M. Whitmer, who paid $15,000 for it. It is the purpose of the new owners to put the plant in first class condition. The company has about 700 subscribers.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has filed its bond of $25,000 as a guarantee that it will comply with the ordinance which provides that it shall install 1200 telephones each year for three years. Business telephones will cost $48 a year and residence instruments $36. The work of laying the underground conduits will be commenced on April 15.

CINCINNATI, OHIO.—A representative of the Trans-State Telephone Company, of Philadelphia, has been in Cincinnati soliciting subscriptions for his company as a competitor of the Bell Telephone Company. An ordinance has been presented to the Board of City Affairs, and operations will be commenced very soon. The same company has commenced operations in Springfield and Columbus, Ohio.

WORCESTER, MASS.—F. W. Breed, treasurer of the People's Telephone Company, has been consulting with people interested in the franchise asked for by the company for rights to maintain telephone poles and conduits in the streets of this city. An agent of the People's Telephone Company, of New York, has visited Pittsfield, Mass., lately and sounded the people regarding a local company.

BALTIMORE, MD.—A syndicate headed by George R. Webb and Harry A. Paer of this city has purchased the Pittsburg & Allegheny Telephone Company, of Pittsburg, and will begin at once to improve and extend the service. Stocks and bonds amounting to two and a half millions of dollars will be issued, to cover the cost of the plant and the contemplated improvements. A first class telephone service at a low price is promised.

HOUSTON, TEXAS.—Messrs. Waterbury and Bucklin, of the new telephone company, of this city, deposited $10,000 in cash in the city treasury, the sum being in the nature of a guarantee that $10,000 of material for the new plant will be here within 60 days, that the work will be under way within six months, and that it will be finished within 18 months. A charter under the name of "The Citizens' Telephone Company of Texas" will be applied for.

FARMER CITY, ILL.—The Farm and City Telephone Company, of this place, has purchased the Citizens' Telephone lines, throughout DeWitt, Logan and McLean Counties, Mr. J. P. Shinneman retiring from the company, and Mr. R. C. Smith taking his place as secretary and treasurer. Mr. B. F. Wasson was elected president and superintendent of the lines. The company will erect 100 miles of metallic lines this spring. It now has about 300 miles of lines.

CASTILE, N. Y.—The Wyoming County Telephone Company has been organized here, to operate a telephone line connecting Castile, Silver Springs, Gainesville, Rock Glen, Warsaw, Pike, Portageville and Perry, Wyoming County, and Mount Morris, Nunda and Dalton, Livingston County; capital, $2000. Directors, Miles A. Hopkins, D. E. Van Arsdale, S. B. Windsor, C. M. Johnson, S. J. Seward Chapman, Castile; E. T. Dudley and Newbern H. Louis, Silver Springs.

SPRINGFIELD, ILL.—The Brundage telephone bill is in a fair way to become the biggest question of the session after the Allen law repeal. The rates fixed in the bill of $60 a year for business and $30 for residence telephones were so low, senators say, that such a law would be oppressive and on that account would be nullified in the courts. The rates once fixed were $85 and $45, but were cut to $60 and $30 by the full committee on municipal corporations. Mr. John. M. Clark, president of the Chicago Telephone Company, is reported to have said that if the Illinois State Senate does not throw out Brundage's telephone bill his company will appeal to the law courts to test its constitutionality.

CLEVELAND, OHIO.—The United States Telephone Company, of this city, is building a line to Kent, Ravenna, Newton Falls and Warren. This line will be the outlet of the independent lines now in operation in Warren and Youngstown. The main line will go south to Columbus, passing through the counties of Medina, Wayne, Holmes, Knox, Licking, Delaware and Franklin. Another will pass through the counties of Summit, Portage, Stark and Columbiana. A third will go through the counties of Lorain, Huron, Sandusky, Wood, Ottawa, Lucas, Fulton and Williams. A fourth will go through Lake and Ashtabula counties. Connections will be made and are already arranged for at the Indiana line with long distance telephone lines in that state. The main Ohio lines will start from Cleveland.

ELECTRIC LIGHT AND POWER.

OTTAWA, ILL.—The Merrifield Electric Light Company has been granted a franchise in this city.

JOPLIN, MO.—It was decided at a recent election in this place that the town should own and control an electric light plant.

KALAMAZOO, MICH.—The Kalamazoo Valley Light & Power Company has increased its capital stock from $100,000 to $500,000.

NEW PALTZ, N. Y.—The plant of the New Paltz Electric Light Company has been sold at auction to W. D. Brinnier, who bought the property for the bondholders.

NORFOLK, VA.—The Norfolk Light & Power Company, with a capital stock of $25,000, has been incorporated by William Rosborough, W. H. Miner, A. E. Krise, E. Black and W. D. Pender.

ST. PARIS, OHIO.—The Hays Construction Company, Troy, Ohio, has been employed to furnish plans and specifications for the electric light plant which this city is about to build.

PLEASANT HILL, OHIO.—The village council has employed the Hays Construction Company, of Troy, Ohio, to draw up plans and specifications for an electric light plant for this place.

CANAJOHARIE, N. Y.—The Montgomery Electric Light & Power Company has been incorporated, with a capital stock of $25,000, to operate in Canajoharie, Palatine and other places in the vicinity.

WASHINGTON, D. C.—According to Consular advices to the State Department, the Uitenhage (Cape Colony) Town Council is making preparations for the introduction of an electric light plant.

GARNER, IOWA.—The Garner Electric Light, Power & Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are E. C. Abbey, Isaac Sweigard, J. N. Sproule and others.

PENDLETON, IND.—The Pendleton Water Works & Electric Light Company has been granted a franchise to establish an electric light system and water works in this place. The combined plant will cost about $34,500.

SEWAREN, N. J.—The Sewaren Company has been organized, with a capital stock of $125,000, to build and operate an electric light plant, etc. The incorporators are Robert W. DeForest, John L. Conover and George Holmes.

PITTSFIELD, ME.—The Pittsfield Electric Light & Power Company has been organized to supply electric light and power in Somerset county. The capital stock is $50,000 and the officers are: President, Arthur B. Lake; Treasurer, Frank L. Smith.

SYRACUSE, N. Y.—The electric light and power company has given a contract for the erection of a three-story addition to its power house in Fulton Street. The new building will cost about $40,000, and the steam and electrical equipment about $150,000.

PEORIA, ILL.—The People's Gas & Electric Company has been incorporated, with a capital stock of $500,000. The incorporators are O. J. Bailey, Sumner R. Clarke, John Wilson, P. B. Miles, Benjamin Warren, Jr., Henry Sandmeyer, Sr., and Theodore Miller.

MONTPELIER, VT.—Some citizens of this place are arranging to organize the Marshfield Power & Light Company, for the purpose of erecting an electric light plant at Mollie's Falls. The company will furnish light and power to Montpelier and adjoining towns. It is proposed to utilize the water power at the falls.

MEXICO CITY, MEXICO.—Ernesto Chavero and Gregorio Gonzales, representatives of an American syndicate, have applied to the Mexican Government for a concession for the establishment of a large industry in the City of Mexico for the manufacture of electrical machinery. It is proposed to invest several hundred thousand dollars in the enterprise.

POTSDAM, N. Y.—The Hannawa Falls Water Power Company has been incorporated to develop power for manufacturing, chemical and electrical purposes through the construction of dams on the Raquette River; capital, $300,000. Directors, William B. Cogswell and John L. King, Syracuse; Ogden H. Toppen and Edwin A. Merritt, Jr., Potsdam; Wallace C. Johnston, Niagara Falls.

RALEIGH, N. C.—The Yadkin Power Company has been granted a franchise by the legislature. It will construct a dam across the Yadkin River near Salisbury and will build a modern electric power plant, which will furnish current for electric lighting in Salisbury, Greensborough and other places. Among the incorporators are Capt. John A. Ramsey, of Salisbury, and J. Lee Maxwell, of Knoxville, Tenn.

FREEPORT, ILL.—The Freeport General Electric Company has gone into the hands of a receiver. Judge Grosscup entered the order on the application of several bondholders, who filed in the United States Circuit Court a bill in which they alleged that the company is insolvent and unable to pay the $78,500 bonds held by them. William O. Johnson, of Chicago, is the receiver, and has given a bond for $15,000.

SAN FRANCISCO, CAL.—The Independent Electric Light & Power Company of this city has been incorporated with a capital stock of $10,000,000. The directors for the first year are Claus Spreckels, John S. Spreckels, Adolph B. Spreckels, Charles E. Hume and W. K. Gibson. It is understood that Claus Spreckels will be chosen president of the company and that it will also enter the telephone field.

WILKESBARRE, PA.—The Lackawanna Valley Electric Light & Power Company has been granted a charter to supply electric current for light, heat and power in Carbondale and adjacent counties. The capital stock is $200,000, the 2000 shares being distributed among the following named gentlemen: T. L. Newell, of Kingston; J. B. Russell, of Wilkesbarre; W. D. Boyer, of Scranton; G. M. Reynolds, of Wilkesbarre.

THE ELECTRIC RAILWAY.

STILLWATER, MINN.—Mr. C. G. Goodrich and Thomas Lowry have been granted a franchise to operate local and interurban street railways.

LEBANON, IND.—The County Commissioners have granted a franchise to the Indianapolis & Logansport Traction Company to operate its line on the Michigan road.

FLORENCE, COLO.—The City Council has granted a franchise to the Florence & Canon City Electric Street Railway Company. The line must be completed and in operation before January 1, 1901.

BALTIMORE, MD.—Cable roads in Baltimore are now things of the past, the United Railways & Electric Company having a few days ago stopped the last cable. All the lines are now operated by electric power.

ELIZABETH, N. J.—An ordinance has been passed giving to the Elizabeth City Railroad Company the right to substitute electricity for horses as motive power. The ordinance establishes a three-cent fare for school children.

HAGERSTOWN, IND.—The Common Council has granted a franchise for an electric road through this place. It is to be a branch of the Interurban Traction Company, which will connect Indianapolis and Richmond by way of the national pike.

JERSEY CITY, N. J.—The McElroy & Grunow Electric Railway System has been organized, with headquarters in this city, with a capital stock of $150,000. The incorporators are G. De Testetics, Peter Whitney, Ferd von Kusserow, all of Jersey City.

JOLIET, ILL.—The motormen and conductors in the employ of the Joliet Street Railway Company have received an advance in their wages. This increase is said to have been voluntary on the part of the company, which enjoyed a prosperous year.

WARRENTON, VA.—An electric railway will probably be built between Washington and Fairfax Court House. The road will be extended to Fauquier, White Sulphur Springs. Messrs. Joseph E. Willard and A. M. Lathrop of this place are interested in the project.

NEW BRITAIN, CONN.—It is stated that the Consolidated Road has been negotiating for the purchase of a large tract of land in Berlin on which to build a new power house. The proposed site is near the old power house and is particularly desirable on account of the water power furnished.

COSTA RICA.—The first electric railroad in Costa Rica is about to be built in the City of San José by the Costa Rica Electric Light & Transportation Company, of San José. Mr. H. T. Purdy is chief engineer of the enterprise. The bulk of the material used by the company will be of American make.

KOKOMO, IND.—The Kokomo Railway & Light Company has been incorporated for the purpose of operating an electric railway and lighting plant in this city. The capital stock is $80,000, and the directors are William P. Stevens, Henry L. Woolfenden, L. J. Kirkpatrick, C. L. Harry and Fremont Woodruff.

TORONTO, ONT.—The Central Algona electric railway franchise has been secured by E. V. Douglas, F. L. Lewis and W. P. Douglas, of Philadelphia. The line, which will be narrow gauge, will run north and west from the Canadian Soo to Matchipicoten Harbor. The promoters intend to develop the pulp trade.

TRENTON, N. J.—The Consolidated Street Car Company has been organized by William P. Chapman, Jr., New York; Albert G. Redley, of Brooklyn, and Francis B. Pollock, Jersey City, to manufacture street cars, automobiles, omnibuses and other vehicles for the transportation of freight and passengers. The capital stock is $18,000,000.

JERSEY CITY, N. J.—The North Jersey Street Railway Company, which recently obtained control of all the trolley lines in Northern New Jersey except the North Hudson County Railway, has completed arrangements for leasing that company's lines. The North Hudson Company operates all the lines in Hoboken, West Hoboken, Union Hill and the townships in the northern part of the county.

YOUNGSTOWN, OHIO.—The Park & Falls Street Railway Company has made a contract with the Youngstown Electric Light Company by which the latter will furnish the necessary power to run the cars on the new line. The company expects to have its road in operation on May 10. The contract is for a period of five years, and nothing will be now done by the railroad company toward building its own power house, steps toward which had been already taken.

CLEVELAND, OHIO.—The Cleveland & Warren Electric Railway Company has been incorporated 10r the purpose of building a 50-mile road through the counties of Cuyahoga, Geauga, Portage and Trumbull. The capitalization of the company is $10,000, which amount will be increased after the preliminaries are effected. The question of entrance into this city is unsettled, but it is the intention of the promoters to build the line this season if the financial part of the project can be carried out successfully. The names of the incorporators are: Hon. Martin Dodge, Hon. C. B. Lockwood, J. E. Phelps, of Chagrin Falls; C. E. Thorp, of May's Mills, and J. B. Corlett.

PERSONAL NOTES.

MR. W. D. PACKARD, of the New York & Ohio Company, Warren, O., is traveling abroad for several months for both business and pleasure.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, was a visitor to New York during the past week, making his headquarters at the Okonite offices.

MR. ARTHUR WARREN, of the Westinghouse Electric & Manufacturing Company, who has been abroad, in Europe, on important business for the company, has just returned.

MESSRS. W. T. BLAINE and S. L. Bailey, who are engineering the independent telephone deal, were at the Hotel Waldorf last week, in consultation with local concerns on the subject.

MR. EDWARD LLOYD COOLEY, formerly of Boston, who has for a number of years been associated with the General Electric Company in Philadelphia, has accepted the appointment of general manager in the New England States for the C & C Electric Company of New York. Mr. Cooley's office will be in Boston.

MR. C. S. KNIGHT, who, it will be remembered, became recently vice-president of the Siemens & Halske Electric Company, has been seriously indisposed at home in Fort Wayne, due to effects of the inclement weather, but is now better and is taking up vigorously a large amount of new and prospective business, at his new headquarters in Chicago.

MR. ROBERT STEWART.—The many friends of Mr. Robert Stewart, Superintendent of Telegraph of the Central Railroad of New Jersey, and District Superintendent of the Western Union Telegraph Company, will be pleased to learn that he is rapidly convalescing from the effects of a severe attack of pneumonia, from which he has been suffering for the past month. He left Jersey City last week for Asheville, N. C., to rest and recuperate. He was accompanied by Mr. C. H. Lyons, Manager of the Information Bureau of the Central Railroad of New Jersey.

POTTER—CANDEE.—Miss Ethel May Candee, daughter of Capt. and Mrs. Willard L. Candee, of 472 Greene Avenue, Brooklyn, and George Herbert Potter, also of Brooklyn, were married on the evening of April 4 at the Church of the Messiah, in Brooklyn. The rector of the church, the Rev. St. Clair Hester, officiated. The maid of honor was Miss Olive H. Candee and the bridesmaids were Miss Nina Sweetland and Miss Florence Burchell. Willard C. Candee was best man and the ushers were T. L. Frothingham, Jay F. Carlisle, Arthur Randall, W. G. Gilmore, Jr., Rufus L. Scott, Jr., and T. L. Coleman. A large reception at the Pouch Mansion followed the ceremony. About 1500 guests were present, including many well known in the electrical field and from different parts of the country. The wedding presents were numerous, handsome and costly.

MR. C. L. OECHSNER.—Two presentations were recently made to Mr. C. L. Oechsner on the occasion of his leaving the General Electric Company for a better position with the British Thomson-Houston Company, in London. The first of these consisted of a fine gold chain and traveling case by Mr. J. G. Barry on behalf of Mr. Oechsner's colleagues in the Schenectady works. The second was made by the Grand High Priest of the St. George Chapter Schenectady Royal Arch Masons, in which body Mr. Oechsner has been a High Priest. This consisted of a beautiful ruby and diamond Knight Templar's jewel. Mr. Oechsner joined the Thomson-Houston Company eleven years ago, and was for some years assistant to the late Chas. J. Van Depoele. After the Thomson-Houston Company was absorbed by the General Electric Company, he became drafting inspector in the Engineering Department of the latter company and has since filled that position. He has many friends in Schenectady, both in and out of the works, who wish him luck in his promotion.

LEGAL NOTE.

MEDICAL BATTERY INJUNCTION.—Justice Francis M. Scott, of the Supreme Court, Part 2, New York, on March 30 granted a permanent injunction in the case of J. H. Bunnell & Co., against the Manhattan Electrical Supply Company, restraining the latter from manufacturing or selling medical batteries similar in appearance and design to the "No. 4 D. D. Home Medical Battery," manufactured by the plaintiff. It is stated that Messrs. Bunnell & Co. intend to proceed vigorously against other manufacturers and dealers who are handling imitations of this battery. The Manhattan Electrical Supply Company has been licensed by Messrs. J. H. Bunnell & Co. to make and sell the battery in question, under royalty.

Trade and Industrial Notes.

THE BOSTON ELECTRIC CONDUIT COMPANY, which moved its plant from Versailles, Pa., to Beaver Falls, Pa., has commenced operations.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, is especially prepared to fill all demands for sockets, switches and cutouts.

POLICE TELEPHONES IN HAVANA.—Mr. F. W. Hawley, of New York City, has been awarded a $22,000 contract to connect the Havana police stations by telephone.

THE E. G. BERNARD COMPANY, of Troy, N. Y., has closed a contract to enlarge the electric light plant of the Arnold Print Works, in North Adams, Mass. The addition will have a capacity of 1200 lights.

THE ALEXANDER-CHAMBERLAIN ELECTRIC COMPANY has moved its offices from 56 West Twenty-second Street to the Astor Court offices, 25 West Thirty-third Street and 18 and 20 West Thrty-fourth Street, New York.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., reports a large increase in its business of lava electric insulators, gas tips, and states that the outlook for 1899 in its part of the country is extremely bright.

THE CASE MANUFACTURING COMPANY, Columbus, Ohio, has just shipped a 15-ton electric traveling crane to St. Petersburg, Russia; also two 30-ton three-motor electric traveling cranes for use in the government power station at Sydney, Australia.

MR. J. W. TROTTER has placed with Messrs. Goldmark & Wallace, 121 Worth Street, New York, the exclusive right to handle his commutator compound. Messrs. Goldmark & Wallace will mail samples free of charge to any address and all orders will be promptly attended to.

THE UNITED CORRESPONDENCE SCHOOLS, 154-158 Fifth Avenue, New York, has just issued a pamphlet containing testimonial letters from students. The writers of these letters speak in complimentary terms of the work of the school and of the benefits derived by them individually.

THE RIDGWAY DYNAMO & ENGINE COMPANY.—In these columns in the issue of March 25, the announcement was made of the opening of an office in New York City, at 141 Broadway, by the Ridgway Dynamo & Engine Company, of Ridgway, Pa. The name of the representatives is McClave & Hamilton, not McClane & Hamilton, as printed.

DISSOLUTION OF PARTNERSHIP.—The partnership of Thomas G. Oakes & Co., 54 John Street, New York, has been dissolved. Mr. Thomas G. Oakes, who has long been identified with the valve business in New York City, will continue the sale of these goods through Messrs. Dame & Townsend Company, 76 John Street, New York, with whom he has become associated.

THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION, 120 Liberty Street, New York City, calls attention to the high grade of its tuition, which is for "the masses, the classes" and for the people at large, as an unsurpassed means of mastering that knowledge of electricity, which is an indispensable element to-day in the education of every man who wishes to, or who must, keep abreast of the world's advance in industry and movement in thought. The papers provided for home study are prepared by leaders in the electrical and mechanical profession and prove very satisfactory to the students, while the cost of such culture is extremely small.

THE RUSSELL & TOMLINSON ELECTRIC COMPANY, 39 Cortlandt Street, New York, reports some very large contracts for its new standard telephones, which are meeting with success. This company has recently equipped several large plants, including the Deane Steam Pump Company, Holyoke,

Mass., the Brainerd & Armstrong Company, New London, Conn., and the People's Bank, New York City.

MR. C. A. JOHNSON, general manager of the Gisholt Machine Company, Madison, Wis., has issued an open letter to machinery manufacturers in the line of an advocacy of lower or abolished duties on machinery, chiefly because they are no longer needed and because they provoke retaliation. The writer of the appeal is on main lines a protectionist, but holds that American machinery no longer needs to be protected.

MESSRS. E. B. LATHAM & CO., 136 Liberty Street, New York, have just issued their 1899 catalogue of Tuerk alternating and direct-current ceiling desk and bracket fans. The fact that these fans stand unchanged, save in a few minor points, is pointed to as evidence of their approach to perfection. Lundell fan motors and Edison battery fan motors are also listed. All of these goods are illustrated and a price list of the various sizes is given.

THE GATE CITY ELECTRIC SUPPLY & CONSTRUCTION COMPANY has just been organized in Atlanta, Ga. It will carry on a general electric supply and construction business in the South. The officers are: President, W. H. Turner; vice-president, J. D. Turner; secretary, Dr. J. P. Kennedy; treasurer and general manager, Oscar C. Turner; superintendent, D. A. Jett. The new company, whose address is 74 North Broad Street, Atlanta, will represent the Dayton Fan Motor Company in Atlanta.

ELECTRIC LIGHT CONTRACTS IN HAVANA.—Mr. J. P. Hall, electrical contractor, 143 Liberty Street, New York, has been awarded a contract by Gen. Ludlow, for the electric lighting of the public buildings of Havana. The amount of the contract is $285,000. The contract calls for a plant equipped with two direct-connected alternators, each with a capacity of 450-kw, to be driven by two 600-hp Corliss engines. Steam will be furnished by three 500-hp boilers.

NEW YORK TELEPHONE COMPANY has issued a very telling brochure, in long-distance style of publication, in which it quotes a number of press utterances on its remarkable record during the February blizzard, when pretty well all that was left to New Yorkers for purposes of communication was their power of speech and the company's service. The work was indeed something to be proud of and the story deserves preservation in even more elegant form.

WESTINGHOUSE TRANSFORMERS.—It is interesting to note the growth of the Westinghouse Company's oil transformer business, the total output of which for the seven years ending December, 1898, was 146,540 horse-power. During the year 1895 the company installed 5000 horse-power in oil-insulated transformers; in 1896, 17,100 horse-power; in 1897, 30,633 horse-power, and in 1898, 90,000 horse-power. The present year will, it is stated, show a record for which the previous years will present no parallel.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, moved into its Norwood plant in December last, and although the increased facilities more than trebled the output, the company has found it necessary to run the factory night and day to keep up with the work. The new plant at East Norwood is a very large one and is well equipped with modern machinery and appliances. All the machine tools are driven by individual motors and the entire absence of belts and shafts is a very noticeable feature.

THE SARGENT ELECTRIC SIGNAL SYSTEM, which will be exploited by the Sargent Automatic Signal Company, whose incorporation was noted in these columns last week, promises to meet with favor among railroads. The apparatus is contained in a signal box which is attached to a pole. Surmounting the box are the safety and danger signals, semaphore arms by day and red, green and white lights by night. The electrical mechanism is simple. Mr. James Sargent, of Rochester, N. Y., is the inventor of the system.

THE SAMSON CORDAGE WORKS, Boston, Mass., has just issued two circulars relating to arc lamp cord and trolley cord and Samson "Spot" cord. The arc lamp cords and trolley cords are put up in coils of about 1000 feet each, and unless otherwise ordered, waterproof finish is always applied to them. The Samson Spot cord is the result of 30 years' experience in the manufacture of solid braid cords. It gets the name "Spot" from the fact that there is a colored fibre running through the braid which spots the cord at regular intervals.

THE SWETT & LEWIS COMPANY, 11 Bromfield Street, Boston, has purchased the business and good will of the American Roentgen Ray Company, which formerly carried on a business on Bedford Street, Boston, of manufacturing static machines and X-ray specialties. The business has been removed to 11 Bromfield Street, where the Swett & Lewis Company carries a full line of static machines, parts and supplies; X-ray tubes, fluoroscopes, tube stands, electro-medical apparatus, etc. The company's new barium fluoroscopes are said to be very brilliant and have a long life.

THE NEW YORK STATE HOSPITAL at Ogdensburg, N. Y., has just installed a new plant, including four Watertown engines. The new four-valve Watertown high-speed engine is making a very satisfactory record for economy. Results are especially satisfactory when the engine is running (as must sometimes happen) at much less than its rated horse-power. For example: This engine whose normal load is 180-hp has at times been put to do the work of only 75-hp, and this it has done with less steam consumption than ordinary high-speed engines of good make of 80-hp.

WORCESTER, MASS.—Mr. Calvin Farnsworth, who controls the hacking franchise at the Union station in this city, is introducing electric lighting on some of his carriages. The current is supplied by storage batteries, the equipment being installed by the Worcester Novelty & Electric Company. The batteries are carried under the driver's seat, and the wiring is entirely concealed within the walls and sides of the carriage. The lamps on either side of the driver's box are of 6 candle power each, and are provided with powerful reflectors. The battery has a capacity sufficient to give nine hours' lighting.

DEMAND FOR LIGHTNING ARRESTERS.—In anticipation of a large demand this spring for its lightning arresters the Garton-Daniels Electric Company, of Keokuk, Iowa, prepared a large stock during the winter months. The company has just doubled its manufacturing force in an endeavor to keep up with the demand for its goods, but it is still shipping faster than it produces. Another addition to the force will therefore be made, so that all orders for lightning arresters may be promptly filled. The company's new catalogue No. 22 has been in such demand that a second edition may be necessary.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., has just issued a folder describing and illustrating the new pattern Bliss inclinable power presses. These machines are adapted to nearly every kind of blank cutting, perforating, forming and combination die work, covering a large proportion of the operations required in the manufacture of electrical goods, brass goods, trimmings, etc. Improvements in detail of construction have been made from time to time, but recently two of the presses have been redesigned with the object of increasing their convenience, durability and wide range of usefulness.

THE KNAPP ELECTRIC & NOVELTY COMPANY is now installed in its new quarters at 125 and 127 White Street, New York. Its increased facilities for handling its rapidly growing business will be appreciated by its many customers. The company's factory, salesroom and offices present the appearance of seasonable activity, occasioned by the increasing demand for the Knapp battery fan. The 1899 model has all the latest improvements and is now as perfect as human skill and ingenuity can make it. Besides its battery fans, this company makes many novelties, and special attention is given to experimental work and goods built under contract.

MR. WILLIAM ROCHE, of New York, manufacturer of the "New Standard" dry battery, will this month remove from his present quarters, at 259 Greenwich Street, to a new and commodious factory at 42 Vesey Street. This change was made necessary by his constantly increasing business, and in the new factory, which has been specially equipped to suit the requirements of his particular line, Mr. Roche will be pleased to welcome his old patrons and new ones as well. Mr. Roche is making the "New Standard" cell in all sizes, from the large "Navy" cell now well known through its use on U. S. battle ships, down to the most diminutive dry battery cell ever made.

MESSRS. S. C. NIGHTINGALE & CHILDS, of Boston, have just made a most important application of their magnesia covering in the new station at South Boston, of the Boston Electric Light Company. They have covered all the boiler ends, tops and headers, all the direct and exhaust steam pipes, the drip pipes, Holly System, the connections between the cylinders and eight heaters. Magnesia was selected for this work after long experience with this material and other steam pipe coverings, and as this is one of the most important plants recently erected in New England, the firm is to be congratulated on the evident excellence of the material it represents.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., has issued an illustrated catalogue of its high-class compound engines which possess features that are worthy of the most careful consideration of steam power users. The company employs a new system of distribution for compound engines, which, it is claimed, produces an economy that has hitherto been unequalled in an automatic compound engine, and it maintains the same high rate of economy for all loads within the capacity of the engine. The mechanical features of the engine are clearly pointed out, and some excellent wood-cut illustrations aid the understanding of the design and operation of the engine.

MR. ALFRED J. THOMPSON, who is the sole representative in Havana, Cuba, of Mr. Thomas A. Edison, the Crocker-Wheeler Electric Company, the Stanley Electric Manufacturing Company, Mr. Elmer P. Morris, the Sterling Arc Light Company, McIntosh, Seymour & Co. and other electrical or engineering firms, reports business on the increase and the outlook for spring trade very encouraging. He has just sold four Crocker-Wheeler generators, 4250 amperes and 10 volts each, to the U. S. Government for a large electrozone plant to be located at Havana. Firms desirous of having their goods introduced on the island should address Mr. Thompson, whose headquarters are at San Ignacio 50, Havana, Cuba.

THE CHICAGO FUSE WIRE & MFG. CO. announces a steady and increasing demand for its Trade Mark line of tested fuse wire and links, and states that its new method of packing in tin boxes has become very popular alike with the dealer and consumer, as it keeps the wire practically air-tight and insures against any possible danger in handling the stock. Conforming to the National Underwriters' rules, this company is placing its trade mark on each fuse link terminal, and states that in this branch of the business it has also made great improvements, which not only enhance the appearance and accuracy of the goods. By an improved process it is able to reduce the cost of making, and thus offset the recent advanced cost of material.

THE PELTON WATER WHEEL CO. has recently installed two wheels in the Ophir Mine, on the Comstock, under such extraordinary conditions as to head as to be worthy of note. One of these is a 36-inch wheel direct connected to a fan used for ventilating the shafts, slopes and drifts of the mines. The other, a 32-inch wheel, direct connected to a dynamo used for lighting the mines. Both of these wheels are located at the Sutro tunnel level, some 1700 feet below the surface, and run under a vertical head of 2020 feet. This is believed to be the highest head under which any water wheel has ever been operated, except a similar wheel furnished an adjoining mine some years ago, which runs under 2100 feet head. Some 15 or 20 Pelton wheels are now running in the various Comstock mines under heads varying from 1200 to 2000 feet —operating dynamos, blowers, hoists, etc.

KENT APPARATUS.—The combined dynamo or motor which the Kent Electric Mfg. Co., Worcester, Mass., has had on the market for several years has lately been improved in several particulars. It was in this machine that the Kent Company brought out the special form of battery motor drum armature, which is now largely used by different makers of battery motors. As a motor this machine will perform any work requiring the same or less power than a sewing machine, running on from 2 to 12 volts as the power is needed. As a dynamo it will deliver two amperes at 15 volts. It is series wound and builds up quickly. It was one of the first small dynamos used for igniting gas engines, but lately the company has brought out a new special dynamo for gas engine work, which will soon be on the market. The combined dynamo or motor is a model machine for experimenters' use, as its working demonstrates a great many of the principles met in modern dynamo and motor engineering. One of the latest improvements on this machine is the form of brush holder. This brush holder is very firm, and holds the brush in a very satisfactory manner.

ELECTRIC APPLIANCE COMPANY.—The record that has been made by this concern is perhaps unique in the history of the electrical supply business in America, and is certainly one of the brightest chapters in the growth of the electrical west. To the steadily sustained efforts of its officers, combined with commercial and technical judgment of a high order, may be attrib-

uted its success, and Messrs. W. W. Low, president, and Mr. T. I. Stacey, secretary and treasurer, are to be heartily congratulated on the present outlook. The company started in business Dec. 1, 1891, using one floor of the building at 242 Madison Street, with 2500 square feet of space. One year later another floor was added. In the latter part of 1894 the entire building, or 8000 square feet, was required. Its present new location, at 92-94 West Van Buren Street, has 30,000 square feet of floor space. The building has five floors and is already busy every inch, in spite of the superior facilities for saving time and economizing space. On the first floor are the private offices of Messrs. Low and Stacey, the general offices, the store proper, and at the rear the freight and express department. On the second floor is the big shipping department, with store and shop, of which Mr. S. A. Dinsmore is in charge. On the third, fourth and fifth floors are splendid assortments of goods in stock, all neatly arranged in bins, or on racks and shelves, according to their nature, classified and indexed in an admirable manner. Each floor has its stock clerk. There are all the latest conveniences for despatch of business in the shape of fast elevators and lifts, telephones, long-distance service, etc.

THE DELAWARE HARD FIBRE COMPANY, Wilmington, Del., has during the past two years increased its foreign business to such an extent that it has been unable to supply the heavy demand made upon it for fibre. The company is now erecting a large plant in the suburbs of Paris, which will have about twice the capacity of the American factory. The plant is being fitted out with all the modern improvements and all the machinery will be run by electric power, the motors being geared directly to the machines. The electrical equipment, from dynamo to motor, will be of the latest pattern and most complete in all its appointments. Instead of the old methods of evaporating the chemicals, the company is installing large vacuum evaporating pans capable of evaporating 24,000 gallons of solutions per day. All of the special machinery used in the business is being built by the different machine shops in Wilmington, and part of it is now being shipped to the Paris factory. The plant is expected to be in operation by July 1. The company reports having entered into contracts with several large users of fibre, which will insure from the start an output of 1,000,000 pounds per annum. Owing to the low cost of raw materials and labor and the consequent great economy in operating, it is believed that fibre can be produced at a price which will be considerably below that of the American factories. Two fibre machines are being installed, each with 6-foot cylinders and a third machine is being built which will make the thinner grades of material in a continuous sheet. Mr. L. C. Van Trump, the superintendent of the Wilmington factory, will sail for Europe within a few weeks, to take charge of the Paris plant, and will remain there permanently as superintendent. Several other men from the Wilmington factory will accompany him.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MARCH 28, 1899.

NOTE.—Owing to a delay in the receipt of patent specifications, the Record this week consists merely of a selected claim for each patent, instead of a general characterization of the invention, such as appeared in the two preceding issues, and as will appear in future issues.

621,778. ELECTRIC LIGHTING GAS BURNER; J. M. Anck, of Philadelphia, Pa. App. filed March 24, 1898. In an electric lighting gas burner, an electrode lever, an insulated member secured to said lever and carrying an electrode and an auxiliary lever pivotally attached to said electrode lever, said auxiliary lever contacting with said member only when it is desired to close the circuit.

621,854. ELECTRIC HOSE SIGNAL SYSTEM; H. Sargent, Cambridge, Mass. App. filed Jan. 21, 1898. In an electric hose signal system a coupling for connecting a line of hose with the engine, having an internally screw-threaded ring of insulating material at one end, which engages a screw-threaded nipple on the engine, and having two circuit wires attached to it, but insulated from each other, which are connected to form a loop, and a battery and bell included in said loop, substantially as described.

621,855. ELECTRIC ARC LAMP; R. Schefbauer, Jersey City, N. J. App. filed March 11, 1898. In an electric arc lamp, the combination of a chain suspending the upper carbon, a sprocket-wheel over which said chain passes, a pulley connecting with said sprocket-wheel, a gripping cord passing over said pulley, a tilting lever and two stops between which it plays, a second lever pivoted to the first, and to which both ends of said cord are connected, means for yieldingly holding the second lever in line with the first, and an electromagnet connected with the second lever and adapted to move it with respect to the first lever when the latter is detained by its stops, whereby the cord is tightened or loosened upon the pulley, substantially as described.

621,860. LOOPING-IN SWITCH; John Shork, Detroit, Mich. Filed March 28, 1898. The combination with a pair of plug sockets forming main circuit terminals, of means for normally maintaining said plug sockets or terminals in electrical connection with each other, a pair of separate connecting plugs adapted for insertion one after another in the respective plug sockets, said plugs constituting the terminals of a branch circuit, and means actuated by the plug last inserted for automatically breaking the electrical connection between said main circuit terminals, thereby including said branch circuit between said main circuit terminals, substantially as described.

621,863. PRINTING TELEGRAPH; S. J. Small, Seattle, Wash. Filed Nov. 13, 1897. In a printing telegraph, the combination with a transmitter, of a letter-strip cutter constructed to cut off strips of varying sizes, a series of switches, means for carrying the cutoff letter strips to the switches, an electric typewriting mechanism, and circuits from the switches to the electric devices for operating the type-bars, substantially as described.

621,876. ELECTRIC ARC LAMP; E. P. Warner, Chicago, Ill. App. filed Dec. 11, 1897. In an electric arc lamp, the combination with a pair of carbons between which the arc is formed, of a plurality of electric conductors surrounding the arc, and means for directing an electric current through said conductors, whereby the distorting effect upon the arc of each conductor is neutralized by the effects of the currents in the remaining conductors, substantially as described.

621,907. ELECTROLYTIC CELL; H. H. Dow, Midland, Mich. Filed March 5, 1897. In an electrolytic cell enclosing electrodes and electrolyte, the combination with a porous electrode having a metallic connection, of a liquid having communication with the pores of said electrode and interposed between said connection and the electrolyte.

621,908. POROUS DIAPHRAGM FOR ELECTROLYTIC CELLS AND METHOD OF PRODUCING SAME; H. H. Dow, Midland, Mich. Filed Sept. 19, 1898. A diaphragm composed of iron hydrate or oxid on the anode side and of alkaline-earth hydrates on the cathode side.

621,963. ELECTRICAL ACTION FOR MUSICAL INSTRUMENTS; W. B. Fleming, Detroit, Mich. App. filed Dec. 30, 1897. A music sheet provided with two series of perforations to regulate the travel of the sheet, said perforations arranged in adjacent pairs, one perforation of each pair being elongated and projecting forward of the corresponding perforation.

621,976. OVERLOAD SAFETY DEVICE FOR ELECTRIC CIRCUITS; L. G. Rowland, Camden, N. J. App. filed Dec. 24, 1897. An overload safety device for an electric circuit, consisting essentially of an electric device, in series with the circuit, having a movable member, said electric device being normally inactive, an electric device, in shunt with the circuit having a movable member, a switch upon the main circuit controlled in whole or in part by the movable member of the shunt electric device, the shunt electric device being controlled by the movable member of the series electrical device and adapted to become active when the series electric device becomes active.

621,984. TROLLEY CATCHER; O. W. Whitehead, Dayton, Ohio. Filed July 18, 1898. In a trolley catcher, the combination with a spool upon which the trolley rope is wound, of a spring controlling said spool to keep the trolley rope taut, and a spring of greater strength to control said spool to draw down the trolley when the latter leaves the wire, mechanism for placing the spool under the control of the stronger spring, and an enlargement on the trolley rope adapted to actuate said mechanism when said trolley rope is drawn from the spool by the trolley when the latter leaves the wire.

622,116. ELECTRIC SWITCH; M. H. Caspari, New York, N. Y. Filed Feb. 25, 1898. An electric switch, comprising a horizontally disposed casing, a line terminal passing through the lower part of the casing, a second insulated terminal entering the casing at a higher elevation than the first one, and an extension of the casing hinged thereto and adapted to be raised above or also below the main casing, the two being connected through the hinge and being partially filled with a conducting fluid.

622,124. SECONDARY BATTERY; W. A. Crowdus, Chicago, Ill. Filed June 8, 1898. In a secondary battery, the combination of a supporting plate or grid with its complemental active material, a flexible porous envelop arranged in a thin sheet and surrounding the plate, and a perforated separator composed of a sheet of porous material arranged to fill the space between the elements and hold the flexible envelop in contact with the plate, substantially as described.

622,133. AUTOMATIC SWITCH FOR RAILWAYS; H. F. Eaton, Quincy, Mass. App. filed Jan. 20, 1896. In a switch device, a fulcrumed switch member, having a recess at its under side and an operating crank therefor independent of and engaging said switch member by means of a ball gearing within said recess, and electro-mechanical devices for moving said crank and thereby said switch member, substantially as described.

622,151. ELECTRIC INCANDESCENT LAMP; C. Howard, London, Eng. Filed May 7, 1898. In an electric lamp, the combination of a bulb, an elongated neck on said bulb, projections on said neck, a cap having notches or gaps to receive said projections, and means external to the cap for locking said cap to said projections, substantially as described.

622,166. ELECTRIC HEATER; J. D. S. Reed, Chicago, Ill. Filed March 25, 1898. An electric heating apparatus comprising an outer casing, an inner core, a wire forming at one end a supply wire and at its other end a return wire and wound between its ends about the core from one end thereof to the other, the several turns of said wire upon the core being insulated from each other and a plurality of insulating plugs mounted in said casing and provided on their inner ends with heads which are interposed between said outer casing and the winding upon the core.

622,177. ELECTRICAL KNOB; C. M. Brown, Newark, N. J. Filed Feb. 26, 1898. In combination with the chambered and open-front knob, open at one side, of a transparent plate, a recessed plate having a pointer adapted to be drawn out at the side opening, a spring holding said plates forward terminals of an electric circuit and a circuit closer.

622,188. KEYLESS SWITCH SOCKET FOR INCANDESCENT LAMPS; M. Meyberg, Los Angeles, Cal. Filed Nov. 14, 1898. In a lamp socket, the combination with a plate of a cap piece thereon; the lower edge of which is turned outward; a sleeve over the cap piece the upper edge of which is turned inward, and screws through the cap piece into the plate above the edge of the sleeve.